VOL. XXIV. — No. 3. MARCH 1947

Monthly Bulletin of the International Railway Congress Association

(English Edition)

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ATELIERS DE CONSTRUCTION OERLIKON, ZURICH (SWITZERLAND)

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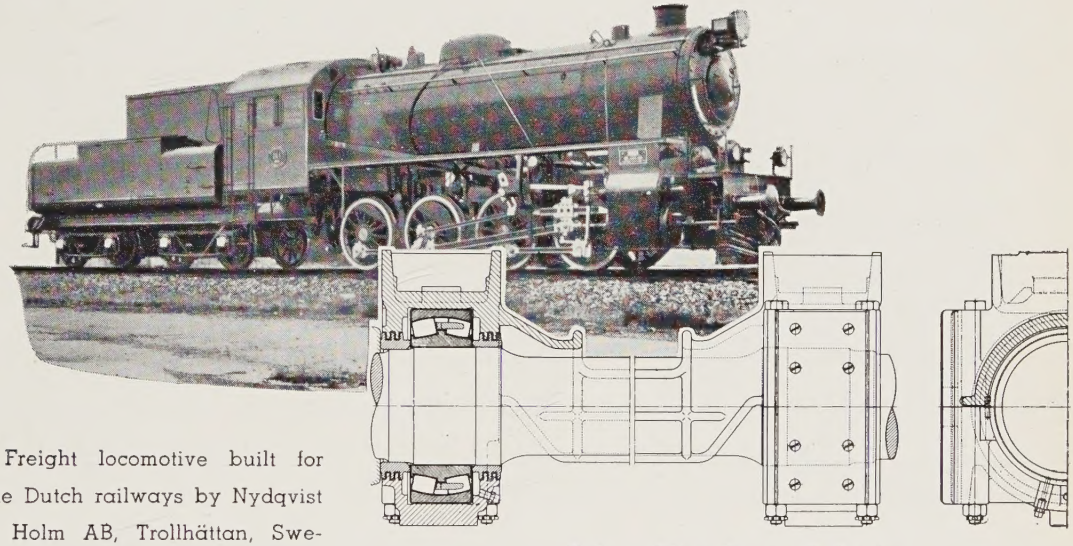
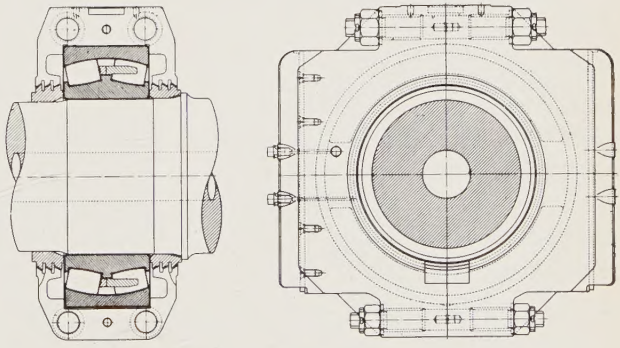


Freight locomotive built for the Dutch railways by Nydqvist & Holm AB, Trollhättan, Sweden. The building programme covers 35 locomotives. Weight 127.8 tons. Axle arrangement 0-8-0.

Twin axlebox for coupled axle.



Axlebox for driving-axle.

SKF

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- Lower maintenance expenses.
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Alphabetical Index of Advertisers

Firms :		Specialities :
Anglo-Franco-Belge des Ateliers de La Croyère, Seneffe et Godarville (Soc.) .	V	Locomotives and Railway rolling stock.
Ateliers des Charmilles (S. A.)	—	Air brakes for railways and tramways.
Ateliers de Construction Oerlikon . . .	II	Electrical equipment for all traction requirements.
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Firth (Thos) & Brown (John), Ltd. . .	—	Railway forgings and tools.
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S. K. F. (Société Belge des Roulements à Billes)	VI	Axleboxes.
Usines Emile Henricot	—	Automatic couplers; steel castings for railway rolling stock.
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MONTHLY BULLETIN

OF THE

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

(ENGLISH EDITION)

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CONTENTS OF THE NUMBER FOR MARCH 1947.

CONTENTS	Page.
I. **The interest the Railway Companies would have in building houses for their staff of all ranks, or in assisting the building of such houses** (Question IV, 14th Congress). Report *(Belgium and Colony, Bulgaria, Denmark, Spain, Finland, France and Colonies, Greece, Hungary, Italy, Luxemburg, Norway, Netherlands and Colonies, Poland, Portugal and Colonies, Rumania, Sweden, Switzerland, Czechoslovakia, Turkey* and *Jugoslavia)* by E. L. ANTONUCCI	277
II. **The interest the Railway Companies would have in building houses for their staff of all ranks, or in assisting the building of such houses** (Question IV, 14th Congress). Supplement to report, by A. P. J. BALL .	353
III. **Sleepers : a) different types; b) maintenance methods; c) financial comparison** (Question I, 14th Congress). Report *(Belgium and Colony, Bulgaria, Denmark, Spain, Finland, France and Colonies, Greece, Hungary, Italy, Luxemburg, Norway, Netherlands and Colonies, Poland, Portugal and Colonies, Rumania, Sweden, Switzerland, Czechoslovakia, Turkey* and *Jugoslavia)* by O. LEDUC	361

CONTENTS *(continued)*.

	Page.
IV. The **International Railway Congress Association** and the **Centenary of the Swiss Railways**	471
V. OFFICIAL INFORMATION issued by the Permanent Commission of the International Railway Congress Association : **Meeting held by the Permanent Commission in Brussels, on the 15th February 1947.** *Appendix :* **List of Members of the Permanent Commission** (15th February 1947).	472

VOL. XXIV. — No. 3. March 1947.

BULLETIN
OF THE
INTERNATIONAL RAILWAY CONGRESS
ASSOCIATION
(ENGLISH EDITION)

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

14th. SESSION (LUCERNE, 1947).

QUESTION IV.

The interest the Railway Companies would have in building houses for their staff of all ranks, or in assisting the building of such houses.

REPORT

(Belgium and Colony, Bulgaria, Denmark, Spain, Finland, France and Colonies, Greece, Hungary, Italy, Luxemburg, Norway, Netherlands and Colonies, Poland, Portugal and Colonies, Rumania, Sweden, Switzerland, Czechoslovakia, Turkey, Jugoslavia),

by E. L. ANTONUCCI,

Ingénieur, Inspecteur en Chef des Chemins de fer de l'État Italien.

I. GENERAL CONSIDERATIONS.

The questionnaire, which we prepared for Question IV, was sent to 97 Administrations, 34 of which replied. Amongst the 63 Administrations which did not answer, two (Spain : R.E.N.F.E., and France : French National Railways) are fairly extensive railways : twelve operate more than 1 000 km. (621 miles) of line up to a maximum of about 10 000 km. (6 213 miles). The other 49 Administrations with less than 1 000 km. of line probably did not reply as the question was not of such interest to them owing to the smallness of their system.

Out of the 34 Administrations who replied, 6 are of great importance owing to the extent of their system, while next come 18 Administrations whose systems vary from a minimum of about 1 000 km. to a maximum of 5 000 km. (621 to 3 106 miles).

The following Companies having a total development of 1 619 km. (1 006

miles) stated that they were unable to give the information asked for :

BELGIUM (Continent) : Compagnie belge de Chemins de fer et d'entreprises;

BELGIUM (Continent : Chemin de fer de Malines à Terneuzen.

FRANCE : Chemins de fer de Gafsa.

NETHERLANDS (Colonies) : Société des Chemins de fer aux Indes Néerlandaises.

SWITZERLAND : Chemin de fer de Viège à Zermatt.

The « Chemins de fer secondaires du Nord-Est » (France) operating 646 km. (401 miles) of line stated that its financial position was such that it could not undertake the building of houses for employees at the present time.

The questionnaire which was sent out in connection with this report and the answers received are given in the following pages.

It was divided into 14 parts covering the different aspects of the problem, and requesting information on the following points :

— the reasons which lead Railway Administrations to build homes for their employees and the ends they hope to achieve by this means;

— the different categories of homes provided by each Administration relatively to the objects in view and the part played by the Railways themselves in buying or assisting the construction of houses and apartments to be let to employees;

— the financing and conditions of financing, the cost of construction and the rents charged, as well as the different types of building;

— the policy followed by the Administrations in allocating accommodation;

— future building programmes and plans for enabling employees to buy their own homes;

— the organisation and working of the department dealing with the housing of employees;

— the housing situation in the country concerned, and the laws, if any, relating to this matter;

— the position of employees renting houses from the Railway.

II. REPLIES TO THE QUESTIONNAIRE RECEIVED FROM RAILWAY ADMINISTRATIONS.

QUESTION 1.

Please give the reasons (technical and economic) which led your Administration to build houses for its employees or assist in the construction of such houses.

ANSWERS.

1. AUSTRIA :

State Railways.

The following considerations led to the building of houses for employees :

a) necessity for making it possible for certain categories of staff to live as near their place of work as possible (for example : stationmasters);

b) necessity for having a sufficient number of houses available for employees in places where the housing shortage is particularly acute (towns) or in places where there are no private lodgings (electric power stations in the Alps);

c) considerations of a social nature.

2. BELGIUM :

a) *Belgian National Railways.*

Technical aspect. — All station-masters, all track inspectors, most gang foremen and a large number of platelayers and crossing keepers are housed by the Belgian National Railways, as well as certain electricians.

The Company requires such staff to live in or near the stations and permanent way, so that they can be called out at night if needs be, when any accident or interruption of the services occurs.

However, in the large stations where there are assistant station-masters, it is not necessary for the station-master to live on the spot.

Economic aspect. — In order to obtain the most advantageous and rational use of the staff (optimum output), the National Railways built houses after the 1914-1918 war in certain places where the housing shortage was particularly acute (Ypres, Montzen).

Social aspect. — If houses are built near his work, in many cases the employee is saved from unnecessary fatigue and the additional risk of accidents on the way to work, and family life is encouraged by reducing the time spent away from home to the minimum.

b) *National Light Railways.*

In 1910 this Company built near the Quévy-le-Grand (Hainaut) Shed, six houses for employees attached to this shed. These houses are still occupied by employees of the Company who pay a very low rent. They are simple houses consisting of two rooms on the ground floor, and two above, with the usual domestic offices and a small garden.

In view of the way the staff is scattered, its relatively small numbers (14 000 at the present time) and its instability, on the one hand, and on the other the existence of many official and private societies to enable the working classes to buy homes, the Company did not think housing estates for its employees necessary or likely to serve any useful purpose.

In addition, laws governing its financial structure would make it difficult to do this.

c) *Brussels to Tervueren Electric Railway.*

This is a subsidiary of the « Electrobel » (Compagnie Générale d'entreprises électriques et industrielles), consisting of a suburban line about 14 km. (9 miles) long, formerly operated by steam by another company on a very small scale.

When taken over by the « Electrobel », it was electrified and a frequent train service on metropolitan lines introduced.

The main purpose of this railway is the transport of passengers; there is free access to the platforms and fares are collected in the vehicles, so that no station staff is required.

The Company which employs about 100 employees was naturally interested in housing the 10 chief employees responsible for the proper working of the service near the place where they have to work.

These employees are housed in the station buildings erected when the steam line was made, which were taken over by the Company.

The Company is merely using buildings already in existence and no programme for the construction of houses for employees is under consideration.

3. BULGARIA :

State Railways and Harbours.

The houses built by the Administration are intended above all for employees and officials whose work requires them to live on the spot. Such categories of staff are housed rent free.

When the requirements of the above categories have been met, any houses available can be let to other employees who have no accommodation near their place of work. If no railway employees require houses, any that are available may be let to employees of other companies or to private individuals.

From the above it is clear that the reason which led the Administration to build houses is on the one hand the necessity for housing the staff near their work, and on the other to help employees and officials of small means by letting them houses at relatively low rents.

4. DENMARK :

a) *State Railways.*

b) *South Funen Railways.*

No information supplied.

5. FRANCE :

a) *Tunisian Railways.*

Most of the lines of the Tunisian Railways run through large tracts of country without villages or towns.

Consequently it was necessary at the start to build houses for all grades of employees and even to build small towns where no urban centres existed.

Later on, as the development of the railway coincided with that of the country, the construction of new houses could be limited by making use of the urban centres which had sprung up alongside the railway.

The houses belonging to the Railway were then let in preference to employees responsible for the safety of the traffic, so that they could easily be got hold of in case of accident.

b) *Congo-Ocean Railway.*

The object of building houses is to enable the staff on arrival in the Colony to live where service requirements indicate.

c) *French West African Railways.*

1) *European staff :* The European staff is essentially a floating one. The length of time spent in the Colony averages two years, and as the staff may have to work in various places on account of this, it is important that employees should not have to worry about houses or furniture. The guarantee concerning housing and furniture is indispensible for recruiting colonial staff.

2) *Native staff :* The numbers of such staff, its native character, and the traditions and customs proper to certain tribes do not favour the systematic construction of large numbers of houses.

However, African employees of grades comparable with those to which houses are allocated in the case of Europeans are also housed by the Company.

d) *Togo Colonial Railways.*

The Administration has had to build houses for all its European staff.

In doing so it was not guided so much by service requirements as by the general necessity for housing employees coming from France to a country where there are not yet any houses available for them.

As regards native staff, the Administration provides a house for the stationmaster in the station buildings, and houses for its agents in the more important railway centres.

Foremen and gangers are also housed by the Administration, but in houses of a temporary nature built in the local fashion.

e) *Morocco Railways.*

This Company has built houses for its staff with the double object of enabling employees to live near their place of work, and to remedy the housing shortage in Morocco.

f) *Damas-Hama Railway and Extensions.*

Before 1939, it was fairly easy to find a house, though there were already signs of a crisis, and the question of houses for the staff was not as yet an urgent one. Service houses built when the lines were made, completed by renting other houses were sufficient.

6. ITALY :

State Railways.

The reasons which led the Administration to build houses for its employees were the following :

— necessity for housing employees, particularly those whose work concerns the safety of the service, near the places where they work, so that they can co-operate more fully and can easily be found in case of need.

With this object in view, houses have been provided at passenger stations, and near stations, depots and other important installations;

— necessity for having houses available at advantageous terms for the greatest possible number of employees, both clerical and executive, to improve conditions for the staff which are often difficult, particularly in large places where it is difficult to get houses at a suitable rent;

— possibility of transferring staff from one place to another according to service requirements and to obtain better utilisation of available labour.

7. NORWAY :

State Railways.

The building of houses for employees has not been carried out on any large scale, and only in cases when the lack of private houses makes such a step necessary, or to enable the staff to live where their work requires.

8. HOLLAND :

Netherlands Railways.

As regards building houses for employees, the necessity for housing the staff where the regular working of the services requires it, and of having available a sufficient number of houses where the housing shortage is particularly bad, has been taken into account.

9. POLAND :

State Railways.

The object of building houses for railway employees is the proper working of the railway services and safety of operation, especially in thinly populated areas and where there is a shortage of houses.

10. PORTUGAL :

a) *Portuguese Railways.*

The building of houses by the Administration has been inspired by the following requirements :

— to enable the staff to live where their work requires;

— to transfer staff quickly as required by the services;

— to have a sufficient number of houses available in places where the housing shortage is particularly acute.

b) *Benguela Railway Company.*

This Company at first built houses for its staff as its lines lay through a new country, where there were practically no houses available.

Although the development of the Colony of Angola, particularly in the region traversed by the railway, has been very considerable and progressive, the Company has continued to built houses for its employees for the following reasons :

— the increase in the European population has not been followed by a corresponding increase in the number of suitable houses, particularly during the last few years, in view of the difficulty of obtaining certain raw materials;

— a large part of the native population wish to profit by the comforts of civilisation and try to get new houses;

— shortage of housing has led to an increase in rents, and consequently means an increase in wages costing

more than it costs the Company to build houses itself;

— finally transfers of employees from one place to another are facilitated in this way.

11. RUMANIA :

Rumanian Railways.

The Administration of the Rumanian Railways has found it necessary to build houses for employees who must live in service houses, and to meet the housing shortage which is particularly acute in large centres (grant aided houses).

12. SWEDEN :

a) *State Railways.*

At first, the Administration applied the rule that all employees should be housed.

With this object in view a certain number of houses and gate houses were built — in addition to the accommodation provided in station buildings.

However, as the number of employees increased, it became difficult to build houses on a corresponding scale, and this moreover was not absolutely necessary in the interests of the service.

Consequently the Administration then adopted the rule that the construction of houses should be limited in principle to those required for employees who must live near their work.

However various circumstances have made it necessary to allocate houses on a much wider scale.

For example, in certain places there are no private houses, so that it was necessary to build houses for other categories of staff if the railway services were to be worked as contemplated.

In addition the housing shortage which has been particularly acute at certain periods, obliged the Administration to get new houses for its staff. Such was the case for example after the first world war, when a considerable number of new houses had to be built. Similar conditions at the present time have led the Administration to ask for a loan from the Government to be able to built more houses.

Sufficient houses naturally facilitate moving employees whenever service requirements make it necessary, but this was not the decisive reason for building new houses.

b) *Göteborg-Dalarne-Gävle Railways.*

The object of building houses for employees is to enable them to live near their work.

c) *Nora-Bergslagen Railway.*

This Company only builds houses for station-masters and crossing keepers.

d) *Grängesberg-Oxelösund Railway.*

The reasons, which led this Company to build houses for the staff, were, on the one hand, the necessity for housing employees, where their work requires, and on the other hand, the necessity to have a sufficient number of houses at their disposal in places where the housing shortage is acute.

e) *Stockholm-Roslagen Railway.*

As it is difficult for staff to find accommodation near their place of work — particularly in the case of station and train staff — the Company has built a certain number of houses in places where the housing shortage is particularly acute.

f) *Västergötland-Göteborg Railway.*

This Company has only built houses for crossing keepers and caretakers, whom it is impossible to house otherwise.

13. SWITZERLAND :

a) *Federal Railways.*

The reasons which led this Administration to give special attention to the

question of housing their employees are of several kinds. First of all the operation of the railway requires a certain number of employees (station-masters, station and shed staff) to live as near their work as possible. In addition, operating requirements make it necessary for staff to be transferred as required without delay from one place to another. Thirdly, the Administration has every interest in having its employees housed in good, hygienic houses at low rentals.

b) *Rhaetian Railways.*

The object of building houses is to house the staff near the station and installations.

14. CZECHOSLOVAKIA :

State Railways.

The reasons which led the Administration to build or encourage the building of houses for its employees are as follows :

1) Service reasons : necessity for enabling the staff to live near their work so that they can quickly be got hold of in case of need; advisability of having employees who do not have to travel a long way to work; possibility of transferring staff without difficulty.

2) Social reasons : to enable the staff to live near their work so that they can profit by the whole of their time off.

3) Financial reasons : to save the lodging allowance which the Administration has to pay in the case of employees who on account of the housing shortage have to live away from home.

QUESTION 2.

What is the policy of your Railway regarding the situation, purpose and allocation of houses for employees ?

Do you provide houses for all grades of employees or only for certain grades? Please give details, also describing the different categories of houses available for the above mentioned cases.

ANSWERS.

1. AUSTRIA :

State Railways.

Houses have been built near stations and level crossings, which are intended above all for the station and train staff, stokers and drivers, as well as houses at some distance from the place of work, in the country or in towns. The latter are occupied by employees of all grades from the highest to the lowest.

A distinction is made between the following categories of houses :

— service houses, which go with the job;

— staff houses; the Administration is free to let these as it pleases, since they are not allocated to certain jobs;

— rented houses; the Administration has relatively little to say in the letting of these as they come under the law concerning rented houses.

2. BELGIUM :

a) *Belgian National Railways.*

The 5 200 or so dwellings belonging to the Belgian National Railways are intended in principle for employees attached to the Operating and Permanent Way Departments, who have to report for work whenever service requirements make it necessary.

Station-masters are housed in the station booking-offices or near by. Houses or cottages for track inspectors, gang foremen and platelayers, electricians and crossing-keepers are spread out along the line over the 4 849 km. (3 013 miles) of the system. There are also garden cities belonging to the Company, particularly at Antwerp, Ghent, Liège, Latour, Erquelinnes and Montzen.

These were built to house certain employees in view of the excessive dist-

ance between the towns and their place of work, especially at Montzen where 297 houses were built, as this important marshalling yard is a long way from any town.

The Belgian National Railways have no intention of building houses for all their employees, 60 % of whom are house-owners.

However in view of the shortage of private houses, they may have to build in certain parts of the country, which were badly bombed during the war.

Houses are allocated to employees on a long service basis; considerations of a family nature may also affect the allocation (large families).

b) *National Light Railways.*

See answer to question 1.

c) *Brussels to Tervueren Electric Railway.*

See answer to Question 1.

3. BULGARIA :

State Railways and Harbours.

State owned accommodation near the stations, depots and shops is used to house employees who must be at the disposal of the railway at all hours.

Other State owned houses for which rent is charged are allocated on the following basis :

— service requirements (priority is given to employees whose work is of such a nature that although not necessarily obliged to live on the job, they can be called upon to report for duty at any time without delay) ;

— length of service (employees and officials with the longest service are given preference) ;

— family considerations (employees and officials with large families are given preference. Batchelors come last).

4. DENMARK :

a) *State Railways.*

Owing to the housing crisis in this country after the first world war as well as the last war, the Administration built a very large number of houses for its employees, especially in the smaller places where there was a lack of private houses.

The houses are intended as a general rule for the lower grades of employees.

The Administration has also built service houses for all station-masters and certain other employees; a large number of crossing keepers are also provided with free houses. The houses for station-masters are usually attached to the main station buildings.

b) *South Funen Railways.*

This Administration only has service accommodation for its station-masters in the station buildings.

5. FRANCE :

a) *Tunisian Railways.*

The obligations of this Company towards its employees as regards housing are as follows :

— Employees who must be provided with houses :

Caretakers, all grades of station-masters, chief assistant and assistant station-masters, shed superintendents and assistant superintendents, spare drivers firemen. Such employees are housed rent free.

— Employees who may have to go on duty during their off-duty hours :

These employees are not housed of right, but have to live in a house belonging to the Company if one is available; they pay a rent which is deducted from their pay.

Included in this group are men who actually replace the shed superintendents and assistant superintendents

on reserve, booking clerks who normally relieve the station-master, and pointsmen; men controlling the repair shops; district inspectors and gang foremen in charge of a section of the line and those who relieve them; inspectors and assistant inspectors of subdistricts, gangers and watchmen, and male and female nurses.

In addition to these, local managers have also been housed in places where housing estates have had to be erected in default of private dwellings; such employees pay rent. Inspectors, assistant inspectors and traffic staff in charge of a section and those who replace them, guards, train inspectors, inspectors, assistant inspectors or checkers of the permanent way in charge of a section and their replacements come under this heading.

Employees who are housed by the terms of their employment or have obligations to be available at all hours are housed near their work (station or shed). The housing estates are also near the stations, but in principle are built some 500 m. away to make them less noisy and smoky.

b) *Congo-Ocean Railway.*

All employees are housed under the same conditions as other officials in the Colony.

Their houses are as near their place of work as possible.

c) *French West African Railways.*

According to their purpose, houses for employees may be classified as follows :

— service houses : these are built at the place of work or nearby and are intended for employees with permanently responsible jobs such as cashiers and storekeepers, or those liable to be called upon at all hours, such as station-masters, shed superintendents and district superintendents;

— ordinary houses : these in principle are built in the place where the general railway services and shops are. Except at Dakar where space is limited, it has been possible to build housing estates for workmen grouped in one or several centres. The Railway is responsible for sewerage, and sometimes for the water supply. These houses are available for all employees needing them.

In every case there is a minimum standard of comfort : kitchen, separate W.C., bathroom with shower or bath, veranda, etc.

In principle the grade and family affairs of the employees are taken into account, so that houses for batchelors or married couples without children will have two rooms, those for families with two children, three rooms, and so on.

d) *Togo Colonial Railway.*

The fact that all officials must be housed by the Company has led to the types of houses built being based not on the function or grade of the employee but on the size of his family.

The General Manager's house is the only one that goes specially with the job.

The railway housing estates usually consist of semi-bungalows, each for the use of one family, built near the railway installations.

e) *Morocco Railway Company.*

When the housing programme was drawn up no provision was made for housing all grades or certain grades of employees.

The houses built were intended in principle for station-masters or assistant station-masters; certain villas built near the sheds are occupied by Rolling Stock & Traction Department staff.

Others have been allocated to District Superintendents. The Management allocates the houses according to proposals put forward by local committees consisting of a representative of each de-

partment which examine and classify applications.

f) *Damas-Hama Railway & Extensions.*

Only employees whose jobs affect the actual railway services are housed by the Company, such as traffic superintendents, shed superintendents, shop foremen, permanent way inspectors and station-masters.

On certain lines there are also hostels for the permanent way maintenance gangs.

6. ITALY :

State Railways.

Houses for the staff of the State Railways can be divided into « patrimonial » houses and « economic » houses.

The former are built by means of a State loan to pay for the work and materials on the « patrimonial account » (new installations, extensions and improvements to stations and lines, new rolling stock, etc.). The loan is paid off by the Administration over a term of years varying from 30 to 50.

The houses in question thus add to the capital assets of the Railway. Many have been built in stations, alongside the permanent way and near other installations for certain grades of employees who must live near their work, such as station-masters, signalmen, head pointsmen, shed superintendents, inspectors, crossing-keepers, district superintendents, etc.

Other houses have been built in places where the staff found it impossible to find decent homes at rents within their means.

Such houses may also be built in places at some distance from the railway and may be allocated to any employee, priority being given to those on the lower rates of pay, taking into account the number and age of their families living at home, the place where they work, the value of the work they do, and service requirements.

The « economic » houses are built by means of loans from the reserves of the « Railway Employees' Pension & Benefits Fund » and the « Saving Funds »; the Railway manages such houses by means of a special department, regulated by law.

These houses meet the same ends and are built to the same standards of workmanship, hygiene and utility as the so-called « patrimonial » houses, and are reserved for staff not actively concerned with the railway services; they are allocated on the same principles as the latter.

7. NORWAY :

State Railways.

Houses are only built for certain grades of employees, such as station-masters, permanent way inspectors, gang foremen, permanent way staff and crossing-keepers. In such cases the employee usually has to live near his place of work (permanent way staff), though houses may also be built owing to the shortage of private accommodation.

In certain places where the housing shortage is particularly acute, houses may also be built for other grades of employees.

8. NETHERLANDS :

Netherlands Railways.

Houses have been built for station-masters, shed superintendents and district permanent way inspectors, as in the interests of the service such employees must live near their work.

Houses have also been built for the lower grades of staff near shops and shunting yards, in view of the shortage of accommodation.

9. POLAND :

State Railways.

There are two classes of houses :

— houses for the traction or permanent way maintenance staff who must live near their work;

— in the case of other employees, houses are being built as fast as funds permit, as near as possible to the place of work;

— to obtain rational distribution of such houses, there are special housing committees, the members of which are appointed by the Administration, who allocate the houses in the first place to those employees who must live at or near their work, and then to employees in need of a house, who have large families.

It is proposed to build houses for all grades of staff. Alongside the permanent way, houses are being built for permanent way inspectors, crossing-keepers, pumping station employees, etc.; in the stations for stationmasters, assistant station-masters, store-keepers, pointsmen, etc.; near the headquarter offices of the various departments for the staff working there.

Near the railway shops and important locomotive sheds building estates have been started where employees are helped to build their own houses.

10. PORTUGAL :

a) *Portuguese Railways.*

Houses are only allocated to certain grades of employees who must live near their work, or who must be available whenever required.

b) *Benguela Railway Company.*

Houses are allocated to employees of all categories and the Company endeavours to find each employee a house suitable for his status and family position.

Certain houses are in principle reserved for employees in certain jobs, so that they can live near their place of work, and also to facilitate transfers.

11. RUMANIA :

Rumanian Railways.

The service houses are in the buildings (stations, etc.) or near them, alongside the permanent way.

The « grant aided houses » are usually grouped in places near large railway centres : stations, administrative offices, shops, sheds, etc.; they are intended for all grades of employees, and allocated solely according to service requirements and the family position of the employee.

The conditions under which houses are allocated are laid down in the regulations drawn up by the General Management of the Rumanian Railways.

Requests for houses are sent to a Central Higher Housing Committee, which consists of delegates from all the Managements and Syndicates, presided over by the Assistance Manager.

Service requirements are taken into account, together with the salary of the employee and his family position.

12. SWEDEN :

a) *State Railways.*

The staff that is housed is in general that which must live near its work.

In this category are included first of all the permanent way inspectors, the gang foremen and the electric operating staff at the sub-stations, as well as a general rule station-masters.

The houses for crossing-keepers are built alongside the permanent way (usually in the section for which they are responsible); houses for inspectors are usually built near the stations, and those for station-masters in the station buildings or sometimes adjoining them. The sub-station staff is housed near their place of work. Houses intended for

other grades of employees are with a few exception built near the station in question.

Houses not reserved for the above grades of employees can be allocated to other employees according to a definite priority relating to service conditions, family position, difficulty in finding accommodation and other circumstances.

b) *Göteborg-Dalarne-Gävle Railway.*

Houses for employees are built near their work so that they can get there quickly. Houses are built for all grades : permanent way engineers, etc.

c) *Nora-Bergslagen Railway.*

As already stated in connection with Question 1, houses are only built for station-masters and crossing-keepers.

d) *Grängesberg-Oxelösund Railway.*

Houses are only built in places where it is absolutely essential. Generally they are near the smaller stations, and in places where there are very few private houses.

e) *Stockholm-Roslagen Railway.*

Houses are only built for certain categories of employees.

Near the stations of Vallentuna and Rimbo, houses are being built for the station staff, train staff and electric services inspectors.

f) *Västergötland-Göteborg Railway.*

Houses are reserved for station-masters and permanent way inspectors in the station buildings, and for crossing-keepers in nearby places if possible.

Houses have been provided in the stations to a limited extend for other categories of employees.

13. SWITZERLAND :

a) *Federal Railways.*

In general only service houses are built, i.e. houses intended for certain categories of staff who, owing to their special duties, must live near their work, for example : station-masters, locomotive depot staff, certain permanent way staff, etc.

In certain places it has been found possible to build houses to rent to the staff.

The allocation of service houses depends not on the rank of the employee but on his job, i.e. the lower grades do not necessarily get the preference.

In station buildings where several flats are available, these are allocated first of all to the station-master or his assistant, or are then rented to superintendents responsible for the permanent way and safety equipment.

Any flats still available may then be let to other station staff. The Federal Railways have followed this practice for many years. At the present time they have about 1 200 service houses in stations, locomotive depots, electric power stations and repair shops; about 1 200 houses for crossing-keepers along the permanent way, and about 200 flats for renting to employees in the railway buildings. Service houses and those that can be rented are all near the place of work.

b) *Rhaetian Railway.*

As a general rule, there are no houses for the administrative staff.

Houses are built for station-masters, crossing-keepers, train staff, traction, shed and permanent way staff.

Permanent way inspectors live in little houses alongside the permanent way; the station-masters in the station buildings, and the rest of the staff in dwellings near their place of work.

14. CZECHOSLOVAKIA :

State Railways.

Houses for the staff are built near the offices and installations, if need be in

groups according to the space available. Houses are provided for employees of all grades. Employees who for service reasons must live near their work and those of moderate means are given priority.

The Railway Administration allocates service houses to its staff; the staff must live in them and pay rent for them. Houses are situated in the station buildings, repair shops, locomotive depots, and those for crossing-keepers alongside the permanent way; there are also other houses built with the assistance of loans from the Railways.

In the allocation of such houses, both those in railway buildings and houses built by means of a loan, the Railway Administration takes service interests into consideration above all, then certain reasons of a financial character, giving preference to employees who have to live away from home and consequently would otherwise have to be paid a lodging allowance, as well as social reasons, such as employees of moderate means.

QUESTION 3.

Apart from building houses, has your Administration taken steps to acquire housing accommodation? Do you run any scheme to assist in the construction of houses and apartments to be let to employees? If so, please give details.

ANSWERS.

1. AUSTRIA :

State Railways.

In order to increase the accommodation available for employees, long term leases of private houses have been taken, in which case the Administration is the chief lessee and sub-lets to its employees.

In order to speed up the building of houses for employees, the Administration instituted the Austrian Railway Building Society.

This Society was set up by means of a grant of municipal credits guaranteed by mortgage and State and Commune funds, the building land being supplied by the Railway Administration, either as a free gift or on a 99 years ground lease.

2. BELGIUM :

a) *National Railways.*

The Belgian National Railways help to provide housing accommodation when necessary. In certain localities they have had to acquire house property in order to accommodate station-masters. 115 station-masters are housed outside their stations.

The Social Services Department of the Belgian National Railways is considering the advisibility of employing a consulting architect to draw up plans for employees who wish to build their own homes.

Apart from building houses itself or through Building Societies, the main object of the Belgian National Railways is to improve housing conditions for its employees and assist them in buying or building suitable homes. It is not proposed to build any more houses to be let to employees unless service requirements make it absolutely necessary to do so.

b) Belgian National Light Railways.

c) Brussels to Tervueren Electric Railways.

Have no schemes on hand for buying or assisting in the building of houses for railway employees.

3. BULGARIA :

State Railways and Harbours.

The Administration helps in building but not in buying houses, and has no schemes under consideration to assist in building houses to be let to employees.

4. DENMARK :

a) State Railways.

b) South Funen Railway.

No information supplied.

5. FRANCE :

a) Tunisian Railway Company.

Since the end of the war, owing to the damage done to Railway property, and to help those hardest pressed, the Administration has bought or rented housing accommodation in certain towns (Bizerta, Sousse, Béjà, Mateur, etc.). These damaged buildings have been put into a good state of repair and the expenditure incurred thereby, met by loans from the Administration, is a liability of the owner, if the property is let; they are then assessed according to the value of the rent.

The Company has not taken any steps to assist in the building of houses by private owners for letting to employees.

b) Congo-Ocean Railway.

The Administration has built all the houses it needs; these are not let to employees who are housed free.

c) French West African Railways.

No houses are being bought. At Dakar where the housing shortage is particularly acute, houses have had to be requisitioned, but this is exceptional and the railway is considering the construction of new houses in this town to ease the situation, taking in account temporary and relief staff.

There are no societies to assist in the building of houses for employees.

d) Togo Colonial Railways.

No.

e) Morocco Railways.

In order to ease the shortage of housing accommodation since the war, the Company has bought houses to accommodate its employees, and is renting 53 houses from private individuals.

f) Damas-Hama Railway and Extensions.

No.

6. ITALY :

State Railways.

To overcome certain difficulties due either to the fact that employees were working in places a long way away from the towns, or to the shortage of private houses, some years ago the Railways bought property in which to accommodate its employees.

In several places where there was an influx of staff during the war from devastated regions, private houses were rented for railway employees. No scheme is in hand to assist in the construction of houses to be rented to employees.

7. NORWAY :

State Railways.

This Administration has bought a limited number of houses.

8. HOLLAND :

Netherlands Railways.

The Administration very rarely assists in the buying of houses. On the other hand, it favours the setting up of societies for building houses to be let to employees.

To obtain the necessary capital for building, loans have been made from insurance companies: these capital sums are usually repaid by means of 50 year annuities.

This plan, which meets the reasonable requirements of both parties, is not intended to obtain houses for employees to live in for service reasons.

9. POLAND :

State Railways.

No.

10. PORTUGAL :

a) *Portuguese Railways.*

The Company buys houses as necessitated by circumstances. No schemes are in hand to assist in the building of houses to be let to employees.

b) *Benguela Railway Company.*

The Company does not buy real estate, as it builds its own houses. It has no plans for assisting in the building of houses to be rented to employees. The latter are either housed by the Company or receive a housing allowance.

11. RUMANIA :

Rumanian Railways.

Negative reply.

12. SWEDEN :

a) *State Railways.*

The Administration to a limited extent has bought houses to accommodate its staff. At the present time there are no schemes to assist the building of houses for employees. This question is however being considered now, as an investigation is being carried out into the housing position as it affects railway employees.

b) *Göteborg-Dalarne-Gävle Railway.*

No.

c) *Nora-Bergslagen Railway.*

No.

d) *Grängesberg-Oxelösund Railway.*

The Company buys houses, but, as when it builds houses itself, only when there is a real need for it.

e) *Stockholm-Roslagen Railway.*

No.

f) *Västergötland-Göteborg Railway.*

No.

13. SWITZERLAND :

a) *Federal Railways.*

No.

b) *Rhaetian Railways.*

No.

14. CZECHOSLOVAKIA :

State Railways.

The Administration buys houses for its employees as well as building them.

Houses are built in collaboration with the Municipal Authorities, a certain proportion of such accommodation being reserved for railway employees.

The construction of houses for railway employees is assisted by the Administration in the sense that it will make advances from the « Railway Housing Funds », which will enable them to carry out the work. Having this at their disposal enables these groups to obtain short term loans to buy the necessary building sites and materials and pay for the labour. Once the houses are built, a long term mortgage is taken out on them, which releases the original funds for the building of other houses.

When the Administration is not building houses on its own behalf but through communal organisations, it usually assists the latter by supplying the plans, authorisation to build, materials and labour, assisting in the acquisition of the necessary building sites, and if needs be supplying them itself if any suitable land is available, and also assuming responsibility for technical supervision and other duties while the work is being done.

QUESTION 4.

Please give the following information regarding the building programme mentioned above : method and conditions of financing, organisation charged with making loans; repayment of capital; average cost per room and per cubic

metre of the building; principles on which rents are fixed; any subsidies granted by your Administration or by the State to enable lower rents to be charged; comparison between these rents and those charged by private individuals.

ANSWERS.

1. AUSTRIA :

State Railways.

The Austrian State Railways Building Society, which has been entrusted with the task of building houses for railway employees, has built 3 to 5 storied buildings, with stairways to 2 or 3 flats on each floor.

In a few other places, 1 or 2 storied houses have been erected with 2 flats to every stairway on each floor. At the present time the Society is responsible for 1 407 apartments. We give below details concerning the building costs, financing and size of flats in a few types of buildings :

— Small block of flats at Vienna-Neustadt (1938-1939) :

3 stories — 118 flats, consisting of :

93/2 roomed flats (1 room, kitchen, hall, closet).
Monthly rent (old shelling) S. 15.50 without any increase;

25/3 roomed flats (2 rooms, kitchen, hall, closet).
Monthly rent : S. 25 without any increase.

Building costs : RM. (new S.) . . .	645 400
Cost of site : RM. (new S.)	23 300
Total RM.	668 700

Financing :

By State credit . . . . . RM.	396 480
Loan from the Vienna-Neustadt Town Savings Fund . . . RM.	158 000
Neustadt Municipality . . . RM.	74 229
The remainder from Administration own funds . . . . RM.	40 000
Total RM.	668 709
Cost of a 2 roomed flat (excluding cost of site) . . . . . RM.	5 060
Cost of 3 roomed ditto . . . . RM.	7 000
Cost per cubic metre of building RM.	32

— Large blocks of flats at Graz (1941-42) : 5 stories — 88 flats of which :

48 are 2 roomed flats (1 room, kitchen, bathroom, dressing-room and hall) ; floor space 41.20 m² (442 sq. ft.) ; monthly rent S. 28.50 plus an increase of S. 12.63;

8 are 3 roomed flats (2 rooms, kitchen, bathroom, closet and hall) ; floor space 65 m² (700 sq. ft.) ; monthly rent S. 37.80 plus an increase of S. 18.04;

12 are 5 roomed flats (4 rooms, kitchen, bathroom, closet and hall) ; floor space 72.8 m² (785 sq. ft.) ; monthly rent S. 43.40 plus an increase of S. 19.50;

20 are 3 roomed flats (2 rooms, kitchen, bathroom, closet and hall) ; floor space 56.7 m² (613 sq. ft.) ; monthly rent S. 34 plus an increase of S. 16.20.

Building costs, without site . . RM.	565 000
The site was given by the Railway RM.	—

Financing :

	RM.	*Repayment.*	*Interest.*
1) *a*) Mortgage from the bank	213 500	1 %	4½ %
1) *b*) Mortgage from the bank	213 500	1 %	4½ %
Railway Administration . .	77 000	1 %	3 %
Estate capital .	61 000		
RM.	565 000		

Cost per flat (excluding site) :

2 rooms, etc. . . . . RM.	7 500
3 rooms, etc. . . . . RM.	11 000
5 rooms, etc. . . . . RM.	17 000

Cost per m² of floor space . . RM.	203
Cost per cubic metre of building RM.	34.97

— Small villas for one or two families in the town of Modling near Vienna, built in 1931 :

10 small villas for one family with ground floor and upper floor, consisting of 2 rooms, 1 small room, 1 kitchen, bathroom, veranda, hall, closet. Floor area 70 m² (753 sq. ft.).

4 small villas for two families consisting of ground floor and upper floor having 2 rooms, 1 small room, 1 kitchen, bathroom, veranda, balcony and hall; floor space for each small villa of 2 flats : 120 m² (1 290 sq. ft.). Monthly rent S. 100. Cost of construction, without site, for a small villa for one family : S. 50 400. Including cost of site, S. 52 000.

In order to reduce unduly high rents due to excessive building costs, the Railway Administration guaranteed rent increases to the Building Society.

These increases vary between 50 % and 100 % of the rent charged, to enable the latter to be within the means of the tenants.

2. BELGIUM :

a) *Belgian National Railways.*

In 1925, the Railway Administration instituted on a non-profit making basis a Society known as « La Prévoyance » formed of those employees interested in the matter and having as its object the building of some 50 houses at Montzen.

The site was supplied by the State and like the houses built thereon becomes the property of the employee when he has paid off his debt to the Society. The funds were lent by the State before the creation of the Belgian National Railways, and the latter supplied an additional loan for the erection of a group of houses known as a « city ».

A fixed annual sum equal to 6 % (including interest at 3 %) is paid by the Society at the end of each year.

The National Railways gave up this practice since it meant that the number of such houses occupied by railway employees in the actual service of the railway constantly declined as they reached pensionable age.

In 1930, a company was created known as the « Antwerpsche Haard der Spoorwegbedienden » with headquarters office in Antwerp, the object of which was the building of 60 houses to be sold or rented to railway employees. The necessary funds were advanced by the « Société Nationale des Habitations et Logements à Bon Marché ».

This solution did not appeal to the staff, who do not like estates reserved solely for railwaymen, situated away from the large towns.

The National Railways which had to pay off any deficit at the end of each year, paid the amounts due to the lending Company and took over all the houses not yet sold. Some of these are rented to corporation employees.

Conditions under which houses are let :

17-42 francs a month — dwellings in blocks with caretakers;

89 fr. a month — dwellings in agricultural districts;

104 fr. a month — dwellings in semi-industrial districts;

119 fr. a month — dwellings in industrial districts.

The rents are increased if necessary by water rates and charges for the use of electric lighting installations.

The average rent for equivalent privately owned accommodation would be 300 francs.

b) *Belgian National Light Railways.*

c) *Brussels-Tervueren Electric Railway.*

See answer to Question 1.

3. BULGARIA :

State Railways and Harbours.

All the houses owned by the Administration were built by sums budgeted for by the Administration itself, this forming part of the general State budget. At the present time, there is no provision for repayment of capital; this is likely to prove necessary however, and will be instituted when the Railway adopts the system of separate administration.

To determine the rents to be charged, the following facts are taken into consideration :

a) The locality. The railway system has been divided into 4 zones. Those in the most populous districts, where the housing shortage is particularly acute, belong to the first zone.

The last zone consists of those places the furthest away from towns, which are not much liked by employees, and here the rents are the lowest.

b) The financial position of the employee. The rents are fixed year by year, according to the economic situation. They are usually 30 to 40 % lower than the legal rents paid by private individuals.

4. DENMARK :

a) *State Railways.*

b) *South Funen Railways.*

These Administrations gave no specific details.

5. FRANCE :

a) *Tunisian Railways.*

At the present time the cost of building is from 8 000 to 9 000 francs per square metre, or 2 500 francs per cubic metre. At the present time an investigation is being made into the possibilities of prefabrication, which it is hoped will lower the cost to 5 000 to 6 000 fr. per sq.m. In principle the Company only builds small bungalows, usually divided into two flats.

The rents which the Administration charges its employees at the present time amount to 125 fr. a month per room, which is considerably below the rents charged by private owners, which are of the order of 250/350 fr. a month per room for houses, for which a moratorium has been granted, and 1 200 to 1 500 fr. a month per room in the case of new houses.

When employees are housed by the Company in flats rented from private individuals, they only pay the usual railway rents and the difference is paid by the Company.

b) *Congo-Ocean Railways.*

Houses are built by the Administration at its own expense.

Type of houses built : small detached villas or built in pairs.

Nothing to be said concerning the rents, seeing that employees are housed free of charge by the Company.

c) *French West African Railways.*

As houses are built by the Company at its own expense, the necessary funds have to be found from the Renewal Fund or by borrowing. The present state of the Renewal Fund makes it possible at the present time to assign a sum of 100 million francs over a period of 5 years for the building of approximately 1 000 houses. The loan will be repaid over 30 years at the rate of 3 millions a year.

The following table gives figures relating to the building costs :

Place.	*Average cost per room.*	*Cost per m³ of building.*	*Cost of a double bungalow. 2 dwellings.*	*Cost of a detached bungalow.*
Dakar	210 000	5 000	1 620 000	1 000 000
Abidjan (Ivory Coast) . .	300 000	6 300	2 000 000	1 250 000
Conakry (French Guiana) .	191 625	4 570	1 510 000	900 000
Cotonou (Dahomey) . . .	182 500	4 350	1 420 000	860 000

It is proposed to build nothing but detached or double bungalows. Employees are housed free of charge.

The rents in the two large cities of French West Africa at the present time are as follows :

— 3 roomed houses with the usual offices (bathroom, kitchem W.C. etc.) 5 000 to 7 000 francs a month;

— 2 roomed houses with the usual offices, 3 000 to 5 000 francs a month.

d) *Togo Colonial Railways.*

The building of houses for employees is financed by means of the ordinary railway budget. The type of building adopted is a separate dwelling for each family at the present time. A semi-raised bungalow consisting of a dining-room, two dressing-rooms, 2 storerooms and the usual offices : kitchen, scullery and linenroom, costs 1 million francs. Employees housed by the Company do not pay any rent at the present time.

e) *Morocco Railways.*

Building is financed by the Railways Capital Funds.

There is no provision for the repayment of capital.

The average cost of building is more or less the same in the different parts of Morocco.

Single, semi-detached, or groups of bungalows:		
Cost per room	fr.	128 000
Cost per cubic metre	fr.	2 285
Blocks of flats :		
Cost per room	fr.	96 000
Cost per cubic metre	fr.	1 715

f) *Damas-Hama Railway & Extensions.*

Supplied no information.

6. ITALY :

State Railways.

The necessary funds for building « patrimonial » houses for the Railway are supplied by the Treasury at a given rate of interest for a period varying from 30 to 50 years, during which the amount borrowed must be repaid by successive payments.

Employees, who for service reasons must live in the houses provided by the Administration, have their rent deducted from their monthly salary, the amounts being laid down in the agreements relating to staff privileges which have been approved by law.

In other cases, the rent charged is appreciably less than the average rents of similar privately owned houses.

In the case of the building of « economic » houses, which is done by an autonomous administration, the Railway Administration has been authorised to borrow at different times part of the surplus funds of the « Railway Staff Pensions & Benefit Fund » as well as those of the « Railway Staff Savings Fund » at a fixed rate of interest of 4½ %.

The Administration includes in its annual budget the sums necessary for the repayment in 50 years of the capital involved in building or buying « economic » houses for its employees and for paying the interest thereon. The tenants do not have to make any capital repayments; the rents are fixed so that they include the interest on the capital invested in the property, cost of upkeep and management, and taxes (generally 7 % of the cost of construction).

Owing to the very high cost of houses built after the first world war, the economic rents would have been beyond the means of the tenants; consequently the Administration was authorised to pay a contribution of 2.5 % towards the payment of interest on capital invested during the period from the 1st July 1919 to 31st December 1922; the Ministry of Industry and Commerce also paid a a contribution of 0.25 % for a period of 50 years on the remaining capital.

In this way it was possible to keep the rents of all the houses built at a fairly low level.

In the case of houses built after this period, no arrangement was made regarding such contributions, except for a small amount from the railway employees' co-operative societies in the case of « economic » houses.

However the Administration, since it could not show a deficit in the management of the « economic houses » and in order to avoid too great discrepancies between the rents of similar houses built at different periods, decided to standardize the rents so that they would be the same in identical types of houses, and be based not on the actual cost of each but on the general average cost of all the buildings.

The following table gives details of the cost of « economic houses » :

Place.	*Year of construction.*	*Type of construction.*	*Average cost per room L. (1)*	*Average cost par m³ of construction.*
	1930			
Turin	»	1—45 flat block	10 165	
Milan	»	1—34 flat block	7 800	
Bolzano	»	1—56 flat block	12 350	
Trieste	»	1—40 flat block	13 100	
Gênes	»	1—48 flat block	9 300	
Pisa	»	1—12 flat block	9 750	
Foggia	»	2—57 flat blocks	10 800	
Licata	»	1—12 flat block	9 325	
Sassari	»	1—74 flat block	12 200	
	1933/34			
Forlì	»	1—20 flat block	8 350	
Florence	»	1—20 flat block	6 700	
Rome — Ricotti Road	»	1—188 flat block	10 800	
Reggio Calabria	»	1—24 flat block	12 400	
Castelvetrano	»	2—12 flat blocks	9 580	
Cagliari	»	3—27 flat blocks	9 980	
	1939/40			
Bolzano	»	1—43 flat block	9 500	
Verone	»	2—70 flat blocks	10 450	
Rome — Prenestine Rd.	»	2—61 flat blocks	11 950	
Foggia	»	1—50 flat block	13 550	
Catanzaro	»	1—8 flat block	15 240	
	1942			
Trieste	»	3—66 flat blocks	22 850	
Gorizia	»	1—32 flat block	23 625	
Rome — Apuania Road.	»	5—161 flat blocks	22 000	
	1943			
Rome — Tor Fiorenza	»	1—240 flat block	29 500	
Rome — G. Boni Road.	»	2—95 flat blocks	32 400	

(1) Counting all rooms including the kitchen but not other domestic offices.

The new programme for buying or building houses.

Various places in the district of :	*Approximate average cost per room (1). L.*
Milan	280 000
Gênes	310 000/440 000
Vérone	250 000/260 000
Bologne	150 000/155 000
Florence	100 000/200 000
Ancône	200 000/250 000
Rome	240 000/320 000
Naples	215 000/280 000
Bari	250 000/300 000
Reggio Calabria	300 000/350 000
Palermo	140 000/160 000
Cagliari	220 000/250 000

(1) Counting all rooms including the kitchen but not other domestic offices.

7. NORWAY :

State Railways.

The rents are fixed to correspond with those charged by private owners for similar accommodation in the same locality.

The Railways does not pay any contribution to reduce the rents.

8. HOLLAND :

Netherlands Railways.

No details.

9. POLAND :

State Railways.

At the present time the Administration is busy rebuilding houses destroyed during the war, as well as new houses, to the extent available funds allow.

The cost of building per cubic metre amounts to 2 500 to 3 000 Zlotys in the case of houses, and the cost of an average sized room amounts to 200 000 Zlotys in all cases.

Before the war some employees of the Railway Administration, particulary drivers and conductors were building their own small homes, but since the war, this has ceased completely, as the staff is much worse off.

The rents of houses for railway employees at the present time are proportional to those charged before the war.

10. PORTUGAL :

a) *Portuguese Railways.*

b) *Benguela Railway Company.*

No information was given by these Administrations.

11. RUMANIA :

Rumanian Railways.

The necessary loans for building houses are assured by the amount budgetted for annually for constructional work.

The average cost for the different types of construction according to the figures for the year 1945, is 1 400 000 lei

per square metre, including the fittings, but excluding the cost of coupling up to main services and road making charges.

The rents of houses recently built by the Rumanian Railways for their employees compared with those charged in the case of similar privately owned houses are in the ratio of 1/20.

12. SWEDEN :

a) *State Railways.*

The cost of building new houses, as well as the cost of major improvements, are covered by loans from a special fund which is put at the disposal of the railways by the Swedish Parliament on request.

The cost of ordinary maintenance and minor improvements is covered by the receipts of the year involved, according to the annual budget drawn up by the Administration and ratified by the King and his Council.

Employees living in houses belonging to the Administration pay rents comparable with those charged for similar privately owned houses in the same district.

b) *Göteborg-Dalarne-Gävle Railways.*

The rents are fixed according to the cost of living in the different places.

The following table shows the difference between rents in places where the cost of living is very high and those in which it is very low :

	Low cost of living.	*High cost of living.*
	Crowns.	*Crowns.*
1 room	60	194.25
1 room and 1 kitchen	120	388.50
2 rooms and 1 kitchen	180	582.75
3 rooms and 1 kitchen	240	777

At the present time these rents have been increased by a supplement of 48 %.

The above rents do not apply to modernised houses.

In the case of houses with an improved standard of comfort (running water, bathroom, central heating, etc.) special supplements are added to the rent.

The rent for such accommodation compares with that paid by private individuals.

c) *Nora-Bergslagen Railway.*

No information supplied.

d) *Grängesberg-Oxelösund Railway.*

No information.

e) *Stockholm-Roslagen Railway.*

Vallentuna : semi-detached bungalows providing four flats consisting of two rooms and a kitchen.

The Administration lends the money to build these without any interest.

Average cost per room : 5 000 crowns.

Average cost per cubic metre of building, excluding cellars : 110 crowns.

There are no subsidies, but compared with the rents paid by private individuals, railway rents are slightly lower.

Rimbo : two storied houses, with two flats on each floor consisting of two rooms and a kitchen.

Average cost : 5 000 crowns per room, 90 crowns per cubic metre of building.

Other details as in the case of Vallentuna.

f) *Västergötland-Göteborg Railway.*

No information.

13. SWITZERLAND :

a) *Federal Railways.*

The rents charged in the case of accommodation let to railway employees are based on the local rents; no special benefits are granted to such employees.

b) *Rhaetian Railways.*

No information.

14. CZECHOSLOVAKIA :

State Railways.

The Administration usually builds three storied houses, the cost per cubic metre being approximately 160 Kcs in 1938. The approximate cost per room was 20 000 Kcs.

QUESTION 5.

Can employees continue to live in railway houses on retirement ? Are the widows and families of deceased employees allowed to remain in occupation ? If so, please give details of the provisions made to house employees succeeding those who have retired or died.

ANSWERS.

1. AUSTRIA :

State Railways.

« Service houses » are only allocated to certain posts.

Such houses must be given up when the employee leaves or retires for the use of his successor.

In allocating « employee's houses », service requirements as well as the needs of the employee are taken into account. On retirement he may be allowed to remain in occupation, or his widow if he dies; no such right is recognised in the case of his family.

In allocating « houses to rent », the Administration has to observe the existing laws on the subject (in Vienna houses are allocated on a points system). If the employee dies, his heirs are entitled to remain in occupation.

Consequently some of these houses are occupied by persons having no connection with the railway.

The Administration is now endeavouring to get such houses out of State control, so that they can be let on the same terms as the others.

2. BELGIUM :

a) *Belgian National Railways.*

Widows of employees and employees on retirement are given 3 months to find alternative accommodation; after this period they must move out.

If however the accommodation is not needed, an additional period may be granted. A lease for 3, 6 or 9 years may even be granted at the usual rent.

Social needs may also be considered; for example, certain families the head of which was killed during the war are allowed to live in houses belonging to the Railway under particularly favourable terms.

b) *National Light Railways.*

c) *Brussels to Tervueren Electric Railway.*

No information supplied.

3. BULGARIA :

State Railways and Harbours.

In principle State owned houses, whether allocated free or on payment of rent, cannot be occupied by employees after retirement.

The only exception made is in the case of employees obliged by the regu-

lations to live in State houses, in the sense that those leaving the service as well as the widows and families of deceased employees can continue in occupation of houses belonging to the Administration for a certain period, which must not exceed 3 months.

4. DENMARK :

a) *State Railways.*

b) *South Funen Railway.*

No information given.

5. FRANCE :

a) *Tunisian Railways.*

On retirement employees must give up their houses; widows and children of deceased employees must do likewise.

A period of grace is sometimes given for humanitarian reasons, but this must be kept as short as possible.

Employees taking over the job receive a special allowance while the house is occupied.

b) *Congo-Ocean Railway.*

Houses are allocated to employees on arrival in the Colony. Each employee is entitled to a house the whole time he remains in the Colony.

Retired employees, widows and children do not remain in the Colony but are sent back to France.

c) *French West African Railways.*

Retired employees, widows and children of deceased employees cannot remain in occupation of houses belonging to the Administration.

Houses can only be occupied by employees actually working on the railway.

d) *Togo Colonial Railways.*

European staff are housed the whole time they remain in the Colony.

The question of housing retired employees does not arise, since on retirement employees return to France.

In the case of native staff, the latter come under the housing provisions made for the whole of the native population by the Government of the territory.

e) *Morocco Railways.*

Retired employees and the widows of deceased employees must vacate houses belonging to the Company, which will be reallocated to employees on active service.

They are only allowed to remain in possession long enough to settle their affairs.

f) *Damas-Hama Railway and Extensions.*

The Company only houses certain employees on active service who must live on the job.

When they leave the service or are transferred to another position, they must hand over the houses to their successors.

6. ITALY :

State Railways.

When an employee gives up his job or dies, his house must usually be given up at the end of the following month.

The Head of the Department may however grant a delay of two months.

At the present time, in view of the critical housing position, it is agreed that retired employees and the widows and chidren of deceased employees can continue to live in such houses for some time, successive extensions being granted to them.

However, as far as possible such families are moved into smaller houses, to make sure that a certain number of houses will remain available for employees on active service who are always the most numerous and require houses to be allocated to them.

7. NORWAY :

State Railways.

Houses are usually allocated to those

employees who have the greatest need for them.

It is agreed that employees must give up possession of such houses on retirement, as must the widows and families of deceased employees.

However, in view of the present housing shortage, it has recently been found necessary to make several exceptions to this rule.

8. HOLLAND :

Netherlands Railways.

On retirement employees must give up houses allocated to them in the interest of the service. Widows and families of deceased employees must also give up houses belonging to the Administration.

9. POLAND :

State Railways.

Railway employees on retirement must give up their houses; the widows and children of deceased employees must do likewise. Before the war in places where sufficient accommodation was available, retired employees and widows were allowed to remain in occupation.

10. PORTUGAL :

a) *Portuguese Railways.*

Houses are allocated exclusively to employees in the active service of the Company. Such houses must be given up when the employee retires or dies.

Widows and families of deceased employees must give up the house 30 days after the death of the employees.

b) *Benguela Railway Company.*

Employees leaving the active service of the Company must also give up their houses.

11. RUMANIA :

Rumanian Railways.

On retirement employees must give up their houses within the year; the only exception is in the case of employees retired on account of accidents during employment.

Widows without children are allowed to remain in occupation for 6 months after the death of their husbands; widows with grown-up children for one year after the death of their husbands; and widows with young children for eighteen months.

At the present time, retired employees are protected by the law which prevents any tenant from being evicted.

12. SWEDEN :

a) *State Railways.*

Employees can continue to live in railway houses on retirement until the next removal day (in Sweden, there are two fixed removal days, i.e. 1st April and 1st October).

Widows and families of deceased employees can continue in occupation until the nearest fixed removal day (1st April or 1st October) three months after the date of death. If the housing position warrants it, the lease can be extended. In this case, the rent remains the same as that paid by the employee.

b) *Göteborg-Dalarne-Gävle Railway.*

On retirement an employee must give up his house. If his successor does not require the house, however, the retired employee or the family of a deceased employee may remain in occupation until it is required.

c) *Nora-Bergslagen Railway.*

On retirement employees must give up their houses; families of deceased employees must do likewise.

d) *Grängesberg-Oxelösund Railway.*

In principle employees cannot continue to live in railway houses after retirement. If the house is not needed, however, they may be allowed to remain.

e) *Stockholm-Roslagen Railway.*

On retirement employees must give up their flats. Widows and families of deceased employees cannot in principle continue to rent accommodation from the railway.

f) *Västergötland-Göteborg Railway.*

On retirement employees and their families lose the right to occupy railway houses.

13. SWITZERLAND :

a) *Federal Railways.*

Officials who are housed by reason of their job, only have a right to such accommodation whilst doing this job.

If they are transferred, retired, die, or are dismissed, the Administration must be given vacant possession as soon as possible.

The same applies to all members of a family when an employee dies. However, if special circumstances justify it, the Administration may allow them to continue in occupation provisionally.

b) *Rhaetian Railways.*

Retired employees and their families are allowed to remain in possession of their houses, until these are needed by the Administration for other purposes.

14. CZECHOSLOVAKIA :

State Railways.

Retired employees and the widows and families of deceased employees have no right to continue in occupation of houses belonging to the Administration, nor in those built by railway funds. However, the Administration is proposing to build special homes for the aged to help retired employees.

QUESTION 6.

Has the accommodation provided to date by your Administration achieved the object which you had in view ?

Please give details of any new building programmes.

Would you consider the object attained if your Administration was in a position to house every member of the staff? If so, what considerations have led you to come to such a conclusion?

ANSWERS.

1. AUSTRIA :

State Railways.

To-day the desired end is still further away than in 1938.

In fact, as housing accommodation for the staff was situated near stations, it was destroyed on a greater scale than privately owned houses as a result of bombing and the fighting in the spring of 1945.

The railway intends to build new houses, but under present conditions, it has not been possible to draw up any programme as yet, seeing that the first task is the repair of the widespread damage to existing houses.

2. BELGIUM :

a) *Belgian National Railways.*

Out of a total of 5 201 dwellings belonging to the Railway :

61 % are occupied by employees for service reasons;

22 % are occupied by persons other than railway staff;

15 % are occupied by employees who do not have to live on the spot in order to assure the regularity of the service;

2 % are occupied by retired employees who have not yet been able to find alternative accommodation.

Apart from houses reserved for employees for service reasons, the Belgian National Railways have built some garden cities; however their object, which was to house all employees who must live near their work has not yet

been completely achieved, as 22 % of such accommodation is let to other persons. Certain employees prefer to travel a long way to work rather than live in the house provided by the Company.

A new building programme has not yet been drawn up; the Company is however considering the possibility of making flats for station masters in or near station booking offices which have to be modernised.

The Railways do not intend to aim at housing all their employees, but prefer to assist them in getting comfortable and hygienic homes.

Belgian people, who are strong individualists and very independent prefer to own their own homes, which they like to build for themselves in places and on sites of their own choosing, to their own requirements. This is the reason why a certain number of the Railways' houses are occupied by other than railwaymen.

b) *National Light Railways.*

Certain proposals have been put forward owing to the housing crisis due to the 1940/1945 war, but the preliminary investigations have not yet gone far enough to be worth describing.

c) *Brussels-Tervueren Electric Railway.*

No building programme in view for the reasons already given in the answer to Question I.

3. BULGARIA :

State Railways and Harbours.

The Administration is faced with a very difficult and complex problem as regards the construction of houses for its employees. Owing to the war, in nearly all the towns (but particularly in the larger ones) there is a very acute shortage of houses, and great efforts are being made to overcome this.

In the building programme to be completed in the near future, provision has been made for building a considerable number of houses. The completion of this programme depends however on certain conditions such as overcoming the shortage of raw materials, tools, etc.

The Administration will consider the desired end attained, when it can provide a house for each employee.

It has been led to this conclusion by the argument that when this is so, the Administration will have created the ideal conditions for assuring regular, safe and continuous transport, seeing that all the employees of the State Railways and Harbours will then always be available to meet all service requirements, and will no longer have to worry about finding accommodation.

Moreover, thanks to this policy, the Administration will play a very successful part in the social security field, which is so important at the present time.

4. DENMARK :

a) *State Railways.*

b) *South Funen Railway.*

No information.

5. FRANCE :

a) *Tunisian Railways.*

At the present time 61 detached or semi-detached bungalows are being built for employees who must live near their work.

This is the first part of a building programme which has been drawn up after careful consideration to make good the housing accommodation destroyed owing to the war.

The second part of the programme covers the construction at Tunis, Bizerta and Sousse (either in the towns themselves or their suburbs) of houses for

those grades of the staff who are not housed by statutory right and have not to be available at any hour, but who are unable to find housing accommodation at the present time owing to the shortage caused by the war.

b) *Congo-Ocean Railway.*

This Company will have achieved its aim when there is a house for each employee.

c) *French West African Railways.*

The programme of new buildings covers :

— 50 detached bungalows for European staff (10 per year), each of which will consist of a dining-room, principal bedroom with dressing-room, two bedrooms for children with dressing-room, a storeroom, kitchen, scullery and veranda. The average floor space is 200 m² costing 5 000 fr. per m², i.e. 1 000 000 fr. altogether.

— 1 600 dwellings for native staff (320 a year) consisting of : 3 rooms, kitchen, veranda, shower, i.e. an average floor space of 92 m² at a cost of 2 500 fr. per m² and 230 000 fr. per house.

d) *Togo Colonial Railways.*

As already said the aim of the Administration is to house all its employees on arrival at the Colony, but this aim has not yet been achieved. The present programme will increase the number of houses, making it possible to demolish some of the earlier dwellings, the makeshift character of which has been accentuated by age.

e) *Morocco Railways.*

This Company's building programme is as follows :

European staff.

1st. section.	— Casablanca	— 6 villas.
	— Rabat-Agdal	— 12 villas.
2nd. section.	— Oujda	— 1 block of 16 flats.
3rd. section.	— Casablanca	— 1 block of 24 flats.
4th. section.	— Rabat	— 1 block of 8 flats.
5th. section.	— Oujda	— 1 block of 21 flats.

Native staff.

Casablanca	— 20 dwellings.
Oujda	— 54 dwellings.
Marrakech	— 30 dwellings.
Sidi El Aidi	— 6 dwellings.

The Company will certainly have to extend this programme, if the materials available permit.

f) *Damas-Hama Railway & Extensions.*

Until recently the houses built by the Administration which as already said were reserved for a certain number of employees on active service, as there was no difficulty in finding private accommodation, were considered more than enough to meet the requirements of both the staff and the service.

Since the war, owing to the general shortage of houses, the question of accommodation has become very acute for other categories of staff, and the Administration is endeavouring to meet this either by converting other available railway buildings or by renting private houses, but in view of the very high cost of materials and labour, it has not yet been possible to draw up a programme for building a series of houses for the staff.

6. ITALY :

State Railways.

In spite of the great number of houses built by the Administration as « patrimonial » houses or « economic » houses for railwaymen, to which must be added

those built by railway employees' co-operative societies, they are still a long way off meeting the requirements of all the employees who want a railway house.

During the last two or three years, such demands have become very pressing owing to the serious housing shortage in Italy as a result of the destruction caused by the war and the number of refugees in the chief towns.

In view of the pressing demand for accommodation, a programme for building new houses in all the chief railway centres where there is the greatest demand is under consideration.

Though these houses will be similar to the « economic » houses and intended for all categories of employees, they will be built in the same way as the « patrimonial » houses, as the « Railway Staff Pensions & Benefit Fund » and the « Savings Fund » have no further surplus available.

With this object in view the Administration has asked the Treasury for a loan of 22 milliards to be spread over three working years, at a low rate of interest under favourable repayment terms which have still to be defined. With this loan, it will be possible to build 19 000 homes with about 85 000 rooms.

Most of these will consist of blocks of flats.

When the programme has been completed, the principles on which the rents of the new homes are to be calculated will have to be gone into, as seeing the high cost involved, it will not be possible to charge the economic rents amounting to 7 % of the cost of the building, as this would be beyond the financial means of employees.

In addition, the Administration proposes to buy private buildings to convert into homes for railwaymen.

In view of the economic advantages of having suitable homes available for employees at a reasonable rent, the Administration contemplates housing the greater part of its staff in the near future.

When this has been achieved, especially in the case of certain categories of employees whose duties are very important and closely linked up with the proper organisation of the services, it should encourage greater efficiency.

It is difficult, however, to foresee when this aim can be achieved, as the Administration has also to make good a great deal of damage to the permanent way, buildings and installations caused by the war.

7. NORWAY :

State Railways.

In view of the housing situation, it is not necessary for all employees to be housed by the Administration.

8. HOLLAND :

Netherlands Railways.

The Administration has not yet achieved its proposed aims. On the contrary, owing to the war, the housing shortage has been increased.

The programme for new buildings has not yet been drawn up.

The Administration has no intention of housing all its employees.

9. POLAND :

State Railways.

It will be a long time before the complete housing programme can be carried out. This programme will require considerable assistance from the Treasury.

At the present time indispensable buildings are being built or repaired.

10. PORTUGAL :

a) *Portuguese Railways.*

The aim of the Administration as regards building houses for its employees

is a long way from being fulfilled, the number of houses available being still insufficient.

b) *Benguela Railway Company.*

The development of the Colony which has led to increased railway traffic has also made it necessary to increase the number of employees.

It is presumed that this progress will continue, and consequently the Company will continue to build houses.

11. RUMANIA :

Rumanian Railways.

The Rumanian Railways continue to carry out their building programme as they wish to be able to provide accommodation for all employees needing it.

A Higher Committee has just prepared a five year plan for the building of 30 000 flats, 8 000 in Bucarest and 22 000 in the provinces.

12. SWEDEN :

a) *State Railways.*

At the present time there is no definite building programme in hand. The future building programme will probably be relatively restricted and could not in any case cover a sufficient number of houses to accommodate all employees, which is not the object of the Administration in any case.

b) *Göteborg-Dalarne-Gävle Railway.*

This Company thinks it has achieved its aim of housing all employees, who must live on their jobs, and does not propose to build any more houses.

c) *Nora-Bergslagen Railway.*

With the building of houses for station-masters and crossing-keepers, the problem of housing the railway staff may be considered as solved.

d) *Grängesberg-Oxelösund Railway.*

The aim has been achieved. There is no new housing programme.

e) *Stockholm-Roslagen Railway.*

With the houses already built, the aim of accommodating employees, where they have to work, has been achieved.

The Company does not intend to build houses for all its employees.

f) *Västergötland-Göteborg Railway.*

The aim has been achieved.

13. SWITZERLAND :

a) *Federal Railways.*

The Swiss Federal Railways do not think themselves obliged to house all their employees. Such a solution to the housing problem is unthinkable in Switzerland. The individual freedom of employees implies that they should be free to live where they please. Only when exceptional circumstances make it impossible for an employee to find suitable accommodation, can he expect to be helped by the Administration. Up to the present the measures adopted have proved sufficient. It seems likely that the present difficulties due to the acute housing shortage resulting from the war will gradually disappear.

b) *Rhaetian Railways.*

The Administration has achieved its aim in the matter of building service houses.

It seems probable that it will not have to undertake any further building, as most employees have their own homes or are lodged by private individuals.

14. CZECHOSLOVAKIA :

State Railways.

Does not think its aims yet achieved.

QUESTION 7.

Do any schemes exist to assist employees in purchasing houses for their own occupation ?

If so, please give full details.

Do you think that the above plan meets all reasonable requirements ? Please specify to what extent it might affect a general programme for the provision of railway owned accommodation for all employees requiring it for service reasons ?

Is the fact that employees want to buy their own homes likely to interfer with the regular working of the railway, as for example employees wishing to refuse promotion because it means going to live elsewhere ?

ANSWERS.

1. AUSTRIA :

State Railways.

The buying of small houses by employees can only be assisted in certain cases by means of the « State Railways Building Society ».

These arrangements cannot lead to any appreciable improvement in the general housing position, as it is necessary to have a much greater number of houses available. The fact that an employee may refuse promotion in order to continue to live in his own house is not likely to affect the working of the railway seeing the relatively small number of such employees.

2. BELGIUM :

a) *Belgian National Railways.*

The National Railways consider it very important to assist in building houses, as most Belgian railwaymen wish to live in their own homes.

Most of the homes built by employees, with or without the assistance of the Company, are detached houses surrounded by a kitchen garden. House and garden fulfil a social role : they are indispensable for promoting family life.

We have created two companies which make loans to employees. One, the « Société Anonyme Home du Cheminot » (Railwaymen's Homes) is approved by the « Caisse Générale d'Epargne et de Retraite » and receives loans from this organisation. It grants mortgages to railway employees for buying or building moderately priced houses for their own use.

The other, known as the « Société Anonyme de Crédit Immobilier des Chemins de fer belges » receives advances from the Railways and is able to raise loans.

Short term mortgages are granted for buying or building houses, and for improving or enlarging a house belonging to the borrower for his own use. Loans are made on advantageous terms : low rate of interest, repayments when the employee wishes of either the whole or a part of the loan, with a fixed minimum payment which will pay off the short term loan in a maximum of 5 years, and the mortgage in 10, 15 or 20 years, etc.

All mortgages include life insurance; if the borrower dies the insurance company pays the Society the amount still due, if he has been regular in his payments. If there is any surplus owing to the fact that he has paid off larger amounts, this will be paid to his heirs.

The National Railways will make loans of up to 70 % of the value of the property, or 77 % in the case of large families. The borrower must therefore find the remaining 30 % or 23 % of the money plus the sum necessary for lawyer's fees.

Short term loans are made under a signed agreement, without any life insurance.

Between 1930 and 1939, the « Home » granted 1 820 mortgages amounting to

56.6 million francs; the « Crédit Immobilier » granted 2 094 mortgages and 459 short term loans, amounting to 5.7 million francs.

Total number of houses repaired or built : 4 000 (including short term loans).

The above plan has not affected the housing programme of the Belgian National Railways for supplying houses to all employees needing them for service reasons. Provision is made for this in Clause 12 of the General Loan conditions, the text of which is as follows :

« The grant of a loan to built or buy a house must not interfer with the possible transfer of the employee concerned, whatever the reason for his change of abode. »

Employees are allowed to let their houses if they are moved or have to live in a house belonging to the Company. They frequently gain thereby, owing to the low rents charged by the Company.

If they refuse to leave their home, they lose their promotion and a junior takes their place. In any case the regular working of the service is not affected.

b) *National Light Railways.*

c) *Brussels to Tervueren Electric Railway.*

Have no plans to assist their employees to buy their homes.

3. BULGARIA :

State Railways and Harbours.

The Administration has no plans to assist employees in buying houses for themselves.

4. DENMARK :

a) *State Railways.*

b) *South Funen Railway.*

Gave no details.

5. FRANCE :

a) *Tunisian Railways.*

For the last 25 years the Tunisian Government has encouraged building societies for the erection of low priced houses let at moderate rents.

The cost (site and building) is advanced by the State at 2 % interest. This amount is repayable by members of the society at the rate of 1/10th. the first year and the remainder over 19 years.

The Administration also grants loans to its employees in certain cases to assist them in building their own houses.

All the above mentioned facilities, of ancient date, are not used at the present time in view of the difficulty of obtaining the necessary building materials.

In the opinion of the Company, no facilities need be given for other purchases of house property by employees, except in large centres and their suburbs where in normal times it is easier to find accommodation and where a certain number of employees like to live.

However the Administration must be in a position to house all its managerial and specialist staff, and must have a sufficient number of houses available so that the staff, which must be housed in Railway houses and employees who must live near their jobs, are properly housed.

b) *Congo-Ocean Railway.*

No plan to assist employees in buying houses.

c) *French West African Railways.*

Have no plan to assist employees to buy houses. At the present time, it does not look as though the buying of houses by native employees could interfer with the working of the railway, since for racial and political reasons transfer of staff are very rare.

d) *Togo Colonial Railways.*

No plan to assist European employees to buy houses; the native staff benefit by the general measures taken for all native employees.

e) *Morocco Railways.*

In order to assist employees to repair or buy a house, the Company agreed, between 1928 and 1933, to grant mortgage loans on the usual terms. The amount of the loan varied from 50 000 to 75 000 francs, and had to be repaid in 15 years.

The total mortgages taken out amounted to 156 covering 10 120 162.90 francs.

In 1932 employees could build houses at a cost of 350 francs per m^2; today the cost has risen to 10 000 francs per square metre.

The buying of property through mortgage loans could not constitute any obstacle to transfers of employees necessitated by service requirements.

f) *Damas-Hama Railway & Extensions.*

No plan to assist railway employees to buy houses.

6. ITALY :

State Railways.

In the period following the first world war, in order to get over the difficulty of recruiting sufficient staff, the Administration assisted the building of houses by railway employees' co-operative societies. With this object, it took steps to provide the Co-operatives with the funds necessary to carry out their programmes. This was done by means of capital loans from the « Railway Staff Pension and Benefit Funds » and the « Savings Bank Deposits » at a very low rate of interest, part of which was paid by the State.

The Administration also granted all sorts of facilities for the transport and supply of materials.

The Co-operatives carried out the work by means of their private technical staff. The Administration on its side looked after the building by setting up a special department for this purpose attached to the General Management.

In this way, in various parts of the railway, 1 850 buildings were erected, 89 of which were large blocks of flats of more than 3 stories, 172 smaller blocks of not more than 3 stories, with not more than two flats per landing; 100 semi-detached two-storied houses; 1 038 semi-detached bungalows and 451 detached bungalows.

A total of 5 470 homes were provided in this way, with a total of some 38 600 rooms, these being estimated by counting in each case in addition to the actual rooms, each cellar or attic as half a room, and the domestic offices (hall, W.C., bathroom and storeroom) as another half room.

The average building cost per m^3 for these properties which were erected between 1921 and 1925 varied between L. 56 and L. 219.

The average cost per room varied approximately between L. 5 000 and L. 21 900.

The average monthly cost per room to cover the repayment of capital and interest varies from a minimum of L. 9 to a maximum of L. 36.

These costs are much lower than the rents per room in private houses in the same places.

The appreciable difference between the average cost per cubic metre of building and per room are due to the cost of labour and materials in the various places, to the kind of building and decorations which conform to local custom, and the very different kinds of foundations required in different places owing to the nature of the soil.

At the present time many Co-operatives have been instituted, which like

their pre-war predecessors are helped by the State and Railway Administration in order that they may achieve their aims, but at the present time no information is available on this subject.

The buying of their own homes through such co-operative societies could not in any way interfer with the working of the railway at the present time, in view of the small number of employees concerned; moreover there is nothing to prevent them letting or selling their homes.

7. NORWAY :

State Railways.

For many years the Administration has granted loans to its employees on favourable terms in order to assist them financially in building their own houses. The Railways Pension Fund grants loans up to 90 %.

The State has also granted subsidies for the repayment of capital up to 40 % of the cost of building. It has sometimes happened however of recent years that an employee living in his own home has preferred to give up promotion owing to the impossibility of finding accommodation in the new place.

8. HOLLAND :

Netherlands Railways.

No plan to assist its employees to buy houses.

9. POLAND :

State Railways.

In addition to the grants which its makes towards building houses, this Administration assists in the construction of homes by protecting the interests of employees co-operative societies and granting them long term loans when the employee is able to provide part of the capital needed. Workmen are given a certain part of the land requisitioned for the construction of railways, and can even obtain building materials at a low rate.

The acquisition of homes by employees did not give rise to any difficulties before the war as regards the regular working of the services, even when they had to be transferred from one place to another.

10. PORTUGAL :

a) *Portuguese Railways.*

This Company has no plan to assist employees to buy houses. They are of the opinion that this might be detrimental to railway interests in the case of employees who, owing to the nature of their work, frequently have to be moved from one place to another.

This objection does not apply to employees who normally work permanently in one place. In such cases the well-being of employees helps them to work better and the railway no doubt is the gainer.

b) *Benguela Railway Company.*

Has no plan to assist employees to buy houses more easily, seeing that accommodation is provided free of charge for all employees.

11. RUMANIA :

Rumanian Railways.

A Credit Society has been created which will make mortgage advances to employees. Between 1921 and 1946, this Society granted 1 927 loans for buying or building homes, and 1 483 loans for the repair of homes destroyed or badly damaged by the war.

The mortgage can be taken on 60 % of the estimated value; the term of repayment is 25 years, and the annual amounts payable must not exceed 45 % of the employee's salary.

No difficulties have so far arisen owing to employees owning their own homes.

12. SWEDEN :

a) *State Railways.*

After being authorised to do so by the « Riksdag » ratified by the King in Council, the State Railways on several occasions have provided funds to enable employees to take out « loans for building their own homes ». In certain places, large colonies of privately owned houses have been built, for example 79, 13, and 21 houses at Ulriksdal, Notviken and Ange respectively.

The necessary sites are supplied by the railway on a ground lease for a certain period (60 years) for which the employee pays an annual ground rent (Ange is an exception to this as here the land has been given freehold). The loan may not amount to more than 18 000 Swedish Crowns. During the period for which the loan is granted — approximately 30 years — interest is payable at a fixed rate of 3.6 %. After the third year an annual repayment of capital is determined, for the next 27 years.

When the borrower retires, or if he is moved without having asked for a transfer, or if he dies, the State Railways will buy back the buildings erected on the site on request.

At the present time, there is no plan to resume such loans for the building of homes under the aegis of the State Railways. There is no need for such a service owing to the public loans granted by the State, which at the present time supplies all the necessary assistance for financing private building.

In a few cases it has happened that an employee living in his own home has preferred to give up promotion rather than be moved to another place. This, however, has never given rise to serious difficulties from the point of view of the proper working of the railway.

b) *Göteborg-Dalarne-Gävle Railways.*

No plan to assist employees to buy houses.

c) *Nora-Bergslagen Railway.*

This Company goes surety for loans made for building private houses.

d) *Grängesberg-Oxelösund Railway.*

In view of the fact that employees frequently have to be moved at short notice, the Administration has no interest in assisting employees to build their own homes. The transfer of employees owning their own homes has sometimes given rise to difficulties.

e) *Stockholm-Roslagen Railway.*

Employees building houses usually profit by reductions in the cost of transporting materials and on the price of the materials themselves.

f) *Västergötland-Göteborg Railways.*

No plan to assist employees in buying their own houses.

13. SWITZERLAND :

a) *Federal Railways.*

The Railways encourage their employees to build homes by granting mortgage loans on first mortgage up to $^2/_3$ of the estimated value. The present rate of interest is 3½ %. At the present time there are 1 400 such mortgage loans.

The Railways also encourage the setting up of Railway employees building co-operative societies by granting them first mortgage loans at 3½ %. In exceptional cases, when the question of building a house is particularly urgent and special financial difficulties arise, the Railway will also share in the capital cost.

At the present time in Switzerland, there are 26 railway employees' co-operative building societies supported by the Administration. They are responsible for 378 families living in blocks of flats and 795 families living in separate houses.

The first such co-operative society

was instituted in 1909, and the last in 1945. The total building costs by the end of 1945 amounted to 41 828 000 francs. Mortgage loans granted by the Administration during the same period amounted to 18 734 000 francs.

From the financial point of view, special mention must be made of the repayment of capital which is fixed at a standard figure of 1 % and the limiting of dividends to a maximum of 4 %.

The Administration does not grant any special facilities for the transport of building materials, etc., used by railway employees' co-operative building societies.

There is no general need to increase the number of service houses available, and consequently the railways have not drawn up any building programme for this purpose.

It sometimes happens that employees living in their own homes will refuse a transfer or promotion for this reason. But this has never led to any difficulties in running the service up to the present, as there are always plenty of other candidates for the post.

b) *Rhaetion Railways.*

In certain cases employees are assisted to build houses by granting them loans at suitable interest. These loans are made by the « Pension & Benefit Funds » of the staff as first mortgage; at the present time the rate of interest is 3¼ % and the annual capital repayment 1 per cent.

14. CZECHOSLOVAKIA :

State Railways.

This Administration does not encourage its employees to build their own homes. The reasons for this are on the one hand service interests — employees owning their own homes cannot be moved at short notice — and on the other hand the fact that only the building of houses to rent can alleviate the present housing shortage.

QUESTION 8.

Please supply details concerning the organisation and working of the Department responsible for building, upkeep and management of staff housing accommodation, as well as the working out and putting into effect of measures to encourage such building; likewise the Department concerned with keeping a check on co-operative or other building societies created in order to build houses for sale to employees.

ANSWERS.

1. AUSTRIA :

State Railways.

Houses owned by the Railway and those built through loans advanced by the Pension Fund are maintained and managed by the Railway Service Department.

New buildings erected by the « State Railways Building Society » are maintained and managed by the Society itself.

The Staff Department includes a section (House Savings), charged with allocating all the above accommodation.

2. BELGIUM :

a) *Belgian National Railways.*

— Houses belonging to the Railway Company.

The complete specification, drawings, scale plans and estimate as well as the carrying out of the work are dealt with by the appropriate section of the Permanent Way Department.

The organisation and supervision of the work is the responsibility of each of the 8 groups, which constitute the National Railways.

Interior repairs, painting and papering, maintenance of the sanitary equipment and fittings, etc. are the responsibility of the tenant.

Outside repairs — roof, guttering, down pipes, outside paintwork, etc., — are the responsiblity of the Railway Company.

— Houses owned by the staff built through a Building Society.

1) The non-profit making savings association « La Prévoyance » is managed by an Administrative Council elected by members of the Association.

The National Railways elect two representatives to look after their interests in the Association.

2) The « Home du Cheminot » has a capital of 4 000 000 divided up into 8 000 shares of 500 francs.

The Belgian National Railways have subscribed 7 993 shares and seven officials of the Company each subscribed one share.

The « Société Anonyme de Crédit Immobilier des Chemins de Fer Belges » has a capital of 500 000 francs divided into 500 shares of 1 000 francs.

The Belgian National Railways subscribed 493 shares and seven officials of the Company each subscribed one share.

Six of these officials are directors of both Societies; one is the special representative of the National Railways. The seventh is the Secretary-Treasurer, who is responsible for everyday management and prepares the business to be submitted to the Administrative Council.

Staff syndicates elect three directors and three commissioners for each of the two Societies. The National Railways also elect three commissioners.

b) *National Light Railways.*

c) *Brussels to Tervueren Electric Railway.*

No information supplied.

3. BULGARIA :

State Railways.

The Administration's houses are built and maintained by tender or by contract by technical undertakings according to a programme approved in advance by the General Manager and drawn up by the « Administrative Service and Social Assistance » Department in conjunction with the Maintenance and Architecture Services.

In addition, there is a special Department responsible for investigating the accommodation requirements of employees and their families, taking an active part in the preparation of the building programme, and managing and supervising all State houses according to the special regulations.

4. DENMARK :

a) *State Railways.*

b) *South Funen Railway.*

Supplied no information.

5. FRANCE :

a) *Tunisian Railway Company.*

The building of houses is dealt with by the Railway on the same lines as other constructional work. The plans, preparatory work and organisation and supervision of the work are the responsibility of the Permanent Way & Works Department.

Each Department (Traction, Operating, Permanent Way) which has an allocation of houses is responsible for collecting the rents due, these being deducted from employees' wages at the end of each month.

The Railway has no special management for Co-operative Building Societies, whose property is not owned by the Railway.

b) *Congo-Ocean Railway.*

The Permanent Way & Buildings Department is responsible for building, upkeep and management of houses.

c) *French West African Railways.*

Houses are built either by the Company itself through the Permanent Way

& Works Department, or by private firms on tender.

The above mentioned Department is responsible for upkeep and management.

The allocation of houses to the staff is decided by the Manager on the advice of a Committee which includes staff representatives.

d) *Togo Colonial Railways.*

Houses are built and maintained by the Permanent Way & Works Department of the Railway. The Head of this Department is the responsible manager. Building may be done on contract, but the Permanent Way & Works Department is always responsible for the management.

e) *Morocco Railways.*

The plans, building, upkeep and management of houses is the responsiblity of the Permanent Way & Works Department.

Upkeep is localised, being carried out by gangs in each Section and District of the system.

f) *Damas-Hama Railway & Extensions.*

There is no special Housing Department; this forms part of the Permanent Way & Works Department.

Upkeep is the responsibility of this Department which also deals with certain isolated individual cases in connection with the management of additional housing accommodation.

6. ITALY :

State Railways.

The preparing of plans and building of « economic » houses is the responsibility of the Railway Works Department assisted by the District Railway Works Sections; the building is done by contract in conformity with the regulations on the adjudication and management of work done by the Administration.

The Railways Works Sections are also responsible for the upkeep and management of the houses in their section.

As regards « patrimonial » houses, the Railway Works Department deals with the plans and building, as well as the upkeep and management.

A section of the Staff and General Affairs Department is charged with co-ordinating the activities of the above-mentioned Departments and making the general arrangements.

In the case of privately owned houses built by Railway Employees' Co-operatives, the Administration only supervises these in a general way through the medium of special offices in the different districts attached to the aforementioned Staff and General Affairs Department.

7. NORWAY :

State Railways.

There is no special Department responsible for building, upkeep and management of staff houses.

8. HOLLAND :

Netherlands Railways.

There is a special administration in charge of the Societies for building houses to rent to the staff.

The Railways elect commissioners responsible for the supervision of this administration.

9. POLAND :

State Railways.

The building, reconstruction and upkeep of staff houses is in the hands of the Permanent Way & Works Department.

This Department is also responsible for the management of buildings and allocation of accommodation. The Financial and Legal Departments deal with the question of encouraging the

building of houses and the supervision of the activities of the Co-operative Societies.

10. PORTUGAL :

a) *Portuguese Railways.*

No information.

b) *Benguela Railway Company.*

The building and maintenance of houses is the responsiblity of the Railway Works & Construction Department.

11. RUMANIA :

Rumanian Railways.

The Railway Works Department prepares the building programme, the carrying out of which is in the hands of the Regional Managements and done by contract.

The Maintenance Department and special Local Departments cover management and upkeep.

12. SWEDEN :

a) *State Railways.*

The building of houses for employees and major alterations thereto are the responsibility of the Building Department which forms part of the Technical Permanent Way Department. The actual work is done by the Permanent Way Department, either itself or on contract. Upkeep is also carried out by this Department.

The supervision of the building of privately owned houses for the staff is in the hands of special Committees set up in each locality.

b) *Göteborg-Dalarne-Gävle Railway.*

The permanent way engineers are responsible for the upkeep and management of houses in their section.

c) *Nora-Bergslagen Railway.*

No information.

d) *Grängesberg-Oxelösund Railway.*

Staff houses like all other Railway buildings are the responsibility of the Permanent Way & Works Department.

e) *Stockholm-Roslagen Railway.*

The building of houses is the responsibility of the Permanent Way & Buildings Department Engineer.

f) *Västergötland-Göteborg Railway.*

The Permanent Way & Works Department Engineer is responsible for the building and upkeep of staff houses together with all other railway buildings.

13. SWITZERLAND :

a) *Federal Railways.*

The building and upkeep of service houses and houses to let is the responsibility of the Building Department. The supervision of Railway Employees' Building Co-operatives is the responsibility of the Chief Financial Department and the Titledeeds Office.

b) *Rhaetian Railways.*

The Administration entrusts the more important building schemes to architects, whereas less important schemes as well as reconstructions are carried out by the Building Department which includes a master-builder (technician) and a draughtsman. This office also deals with the special upkeep of housing property owned by the railway. Ordinary upkeep is the responsibility of the engineers and inspectors of the Company, who employ railway employees or private labourers to carry out any work required.

14. CZECHOSLOVAKIA :

State Railways.

The Administration has its houses built by private contractors, but the management of the work is the responsibility of its technicians.

QUESTION 9.

Financial repercussions of the construction and management of the aforementioned houses on the budgets of the Railway Administrations.

ANSWERS.

1. AUSTRIA :

State Railways.

As the Administration was obliged to grant subsidies to the «Building Society» to make it possible to lower the rents, which were unduly high owing to the high cost of building, a heavy burden, hard to carry, was imposed on the railway budget.

2. BELGIUM :

a) *Belgian National Railways.*

The National Railways had to meet every year a deficit of approximately 100 000 francs for the « Antwerpsche Haard der Spoorwegbedienden » Building Society.

Since the winding-up of this Society, there has been no financial charge on the National Railways owing to the existence of the « La Prévoyance » Lending Society which is a non-profit making concern. They receive varying dividends for their participation (shares subscribed) and a fixed interest on the loans they make.

The Lending Society is responsible for all administrative and managerial costs: staff, offices, heating, lighting, clerical, printing, taxes, etc.

b) *National Light Railways.*

c) *Brussels-Tervueren Electric Railway.*

No details supplied.

3. BULGARIA :

State Railways & Harbours.

The cost of building houses for the staff and the management thereof is included in the railway budget which forms part of the general State budget.

4. DENMARK :

a) *State Railways.*

b) *South Funen Railway.*

No details given.

5. FRANCE :

a) *Tunisian Railways.*

No information.

b) *Congo-Ocean Railway.*

Did not supply any details.

c) *French West African Railways.*

When the building programme prepared by the Administration detailed under Question 6 has been achieved, the Railways will own :

— 800 houses for European staff;

— 1 600 houses for African staff.

Altogether a capital of 1 840 million francs will be invested in these houses.

If the annual interest, upkeep, and management costs and all other expenses involved be taken at the modest estimate of 8 % on this capital, it means that a sum of about 150 millions would have to be included in the annual budget for this purpose.

It must be pointed out, however, that the houses already built were erected at a time when the cost was nothing like it is at present. Moreover, the upkeep and management expenses are already effectively accounted for in the Operating Accounts under the heading « Current Operating — Staff — Materials — New Works » so that only the interest and repayment of capital need be budgeted for under a separate heading.

It is not possible to determine the exact percentage of the housing costs relative to total costs. It may be said however that they are about 15 % of the total expenses.

d) *Togo Colonial Railways.*

Gave no details.

e) *Morocco Railways.*

The rents of houses allocated to the staff are deducted from their wages and entered under the heading « Receipts other than traffic » in the operating account. The expenditure involved in the upkeep and management of these houses comes under operating expenses. The returns from mortgage loans granted to employees are entered as « Sinking Fund Charges » in the case of the capital repayment, and credited to a capital account in the case of interest on the loan.

f) *Damas-Hama Railway & Extensions.*

Gave no details.

6. ITALY :

State Railways.

The management of the « economic » houses for railway employees showed a deficit even before the war, which increased year by year, and now that the reserve funds are exhausted this deficit must be met by the Railway budget.

The main cause of the déficit must be attributed to the considerable increase in the cost of upkeep of the buildings as well as their management, which are not compensated by a corresponding increase in the rents which must of necessity remain at a level that the staff can afford since their financial position, particularly during the last few years, has gone from bad to worse. This deficit, which may be attributed above all to the upsets of the war, may be gradually eliminated as matters improve.

The « patrimonial » houses, as already explained, are built by means of funds supplied by the Treasury to the Railway with the object of carrying out work which will increase the capital assets of the railway, so that they have no financial effects on the railway budget.

7. NORWAY :

State Railways.

No answer.

8. HOLLAND :

Netherlands Railways.

Any deficits arising from housing the staff are borne by the Railways.

9. POLAND :

State Railways.

Special funds are used for building new houses and rebuilding houses which were totally destroyed. The railway must be budget for the repair of houses which were less seriously damaged.

10. PORTUGAL :

a) *Portuguese Railways.*

Gave no details.

b) *Benguela Railway Company.*

In view of the shortage of houses, rents are very high. The cost of housing the staff is less than the expenditure that would be involved if wages were increased to the extent necessary if employees had to pay such rents.

11. RUMANIA :

Rumanian Railways.

The funds allocated to the building of houses depend on the annual budget. Administrative expenses are included in the budget of the Maintenance Department.

12. SWEDEN :

State Railways.

The most recent statistics shows that the annual cost to the Railways of

managing, heating, upkeep, and improvements to houses amounts to 3.9 million crowns. This sum does not include interest and repayment of capital. The receipts from rents amount to 4.1 million Swedish crowns.

b) *Göteborg-Dalarne-Gävle Railway.*

The rents of houses do not cover expenditure, so that there is a deficit in the Administration's budget.

c) *Nora-Bergslagen Railway.*

Gave no details.

d) *Grängesberg-Oxelösund Railway.*

The rents charged for staff houses are only sufficient to cover the management and upkeep costs of such buildings.

e) *Stockholm-Roslagen Railway.*

The financial effects of the building and upkeep of houses on the railway budget are very limited.

f) *Västergötland-Göteborg Railway.*

Gave no details.

13. SWITZERLAND :

a) *Federal Railways.*

The cost of building service houses and houses to let to employees comes under the general building account and no separate account is kept. The supervision of railway staff building co-operatives does not involve the Administration in any appreciable expense.

b) *Rhaetian Railways.*

The financial effects of the building and upkeep of houses on the railway budget are very limited.

14. CZECHOSLOVAKIA :

State Railways.

The building of houses for railway employees involves the Administration in considerable expense. The budget for the year 1947 makes provision for an expenditure of 100 000 000 Kcs under this heading, and it is also estimated that the Ministry of Social Insurance will contribute a further 200 000 000 Kcs.

QUESTION 10.

Are any Government or Municipal houses allocated to railway staff in your country?

ANSWERS.

5. FRANCE :

d) *Togo Colonial Railways.*

As the Administration of the Togo Railways is part of the local Government, all the houses are in fact Government houses, but only those built at the expense of the Railway are available for railway staff.

14. CZECHOSLOVAKIA :

State Railways.

Accommodation is reserved for railway staff in buildings erected by the State. There are not many such, however.

The other Administrations consulted did not report the existence of any State or Municipal accommodation for railway staff in their country.

QUESTION 11.

Please give details of the characteristics of the types of buildings adopted and the methods of building used, the policy followed in grouping houses and the use of available open spaces, as well as details of the policy to be followed in the future.

ANSWERS.

1. AUSTRIA :

State Railways.

In building houses for railway staff, preference is given to blocks of flats,

with several flats on each floor; such buildings may have up to 5 stories. Small houses are also built for one family, with three to five rooms and a garden.

2. BELGIUM :

a) *Belgian National Railways.*

— Characteristics of the types of buildings erected :

Experience was only obtained on a small scale immediately after the 1914-1918 war. Houses were built to meet the most pressing needs, and it cannot be said that they presented any well defined characteristics.

Moreover, at that period, the shortage of materials made it impossible to study building from this aspect.

— Ypres Garden City.

This consist of 55 houses built between 1920 and 1921. They were built in groups of 2, 3, 4 and 8 houses. These houses were allocated to the following grades of staff : platelayers, labourers, workmen, stationmasters and assistant stationmasters.

As they had to be built of whatever materials were available immediately after the 1914-1918 war, the standard could not be as high as desired.

Nor did the occupation of these houses meet with the success the National Railways expected. Out of the 55, only 30 are occupied by railwaymen.

b) *National Light Railways.*

c) *Brussels-Tervueren Electric Railway.*

No details given.

3. BULGARIA :

State Railways and Harbours.

The Bulgarian State Railways are erecting the following types of buildings :

— dwellings for employees housed free of charge and houses rented to employees who have no house of their own;

— canteens where the staff can get meals whilst on duty;

— hostels where the staff can spend the night when on duty away from home;

— rest centres in spas to which sick employees can be sent.

Houses in large centres where large numbers are involved are built in groups as independent estates, and the open spaces are laid out as gardens. In future, it is proposed to build maternity centres, co-operative stores, cinemas, recreation grounds, etc., in all such railway colonies.

4. DENMARK :

a) *State Railways.*

b) *South Funen Railway.*

Gave no details.

5. FRANCE :

a) *Tunisian Railways.*

The Administration have built several types of houses.

They are usually semi-detached houses built in the centre of 1 000 to 1 500 m² plots, normally laid out as gardens. These houses consist of either 2 rooms, kitchen and W.C., or 3 rooms, kitchen, dressing-room and W.C., or 4 rooms, kitchen, bathroom and W.C.

Most of the types built have a covered-in veranda; a separate wash-house and hen-house is usually built near each house for the use of the occupants. Some of them also have a cellar and a loft.

Before 1939, most of the houses were built of masonry with tiled loft and roof. Since the war, owing to the shortage of wood and iron, it has been necessary to roof the houses with « Rhorfas », and this type of roofing has also had to be

used since the end of the war to replace damaged structures.

« Rhorfas » is essentially a semicircular form of construction using hollow bricks with 3 holes, pugged with plaster, laid flat without any framing being used, the bricklayer being guided by lines attached to the outer walls. In this way, very elegant plain or elaborate arches can be made without using any wood. A layer of stones, as flat as possible and about 10 cm. ($3^{15}/_{16}$") wide, is laid above the bricks, pugged with fatty lime, then 5 cm. ($1^{31}/_{32}$") of concrete made of one third clay, one third fine gravel or sifted ashes, and one third of fatty lime; this concrete is pugged and laths used to increase its compactness to the maximum.

A thick double coating of fatty lime completes the roofing; the object of this is to seal the pores of the concrete and give it the white tinge characteristic of the towns and villages of Tunisia where the houses are generally in terraces or « Rhorfas ».

The principle used in this method is a very ancient one. It derives from the Carthaginian or Roman arch, in which the former wooden framework has long been replaced by an arch made of bricks covered with plaster.

From the technical point of view, bricks enable a thin self-supporting bearing arch only 5.5 cm. ($2^{11}/_{64}$") thick to be made and the plaster which sets very quickly makes it possible to do without any framing. The use of fatty lime, which has no appreciable shrinkage, especially in concrete well packed down, prevents the formation of a multitude of little cracks, which will let the wet in; finally a thick semicircular form of roofing like the above improves the house by conserving coolness in summer and heat in winter.

The arches used in the country rarely exceed 3.5 m. (11' $5^{13}/_{16}$") span and are usually more or less regular in outline; since 1940 arches of 5 to 6 m. (16'5" to 19'$8^{1}/_{4}$") span have been made very successfully, especially on the railways, thanks to the care taken in the design and the quality of the work.

The new houses under consideration (about 60) will be designed and erected according to the most up-to-date criterions of town-planning, comfort and hygiene; they will be semi-detached bungalows set in gardens, so built that the chief rooms will have the best aspect (south and east).

In view of the humid atmosphere and the daily and seasonable variations in temperature which occur in Tunisia, any light type of construction is impossible; the walls and roof must have great calorific inertia and the problem of ventilation has to be specially studied.

Tests of prefabricated building are now being made in Tunisia; it would appear to be possible to use prefabrication for certain important parts of the structure with good financial results.

b) *Congo-Ocean Railway.*

Small semi-detached or detached houses are built.

c) *French West African Railways.*

There is no standard type of building. Houses are built of large slabs of laterite or sandstone, or small stones. The ceilings are made of fibro-cement or plastered brickwork. The walls are made of wood or metal. The roofs are tiled.

The bungalows are grouped in estates in the large centres, each one being surrounded by a garden.

Wide shady avenues lead to the estates. In small places, the houses are grouped round the stations.

d) *Togo Colonial Railways.*

Type of construction adopted : Semi-raised bungalow, built in single units

of stone or cement bricks, covered with sheets of everite. Each bungalow and the land round it is for the private use of a family.

Dining-room, storeroom, kitchen and scullery in each house; the number of rooms and closets varies according to the size of family.

e) *Morocco Railways.*

Buildings are made of slabs of stone, the roof being of earth or tiles on a wooden or metal framework.

Houses consists of 3 or 4 rooms, kitchen, bathroom, W.C. and wash-house.

When the houses are erected in groups, each tenant has a garden attached to his house.

A pleasure garden is attached to each of the small and large blocks of flats.

f) *Damas-Hama Railway and Extensions.*

No regulations are laid down as regards the methods and type of building.

6. ITALY :

State Railways.

The Works & Building Department has investigated various types of building, particularly in the case of small and large blocks (small semi-detached houses or terraces) as well as gate-houses, in view of the fact that this is closely linked up with the problem of making the best possible use of the site available.

It is usually a question of building moderately priced houses in threes, and every endeavour is made to give each flat windows on two sides; the average size of the rooms is 12.50 m² (134 sq. ft), with an outside wall of at least 20 m² (215 sq. ft); the kitchens are usually about 12 m².

The method of construction employed is usually a concrete framework, especially in districts where earthquakes occur, or in the case of big blocks or where there is particular difficulty with regard to foundations.

On the other hand, stonework or brickwork is used when local conditions favour the use of such materials.

In large centres, the railway houses often form a considerable proportion of the houses in the place. In such cases, the grouping of the houses is determined by the town-planning scheme, and when there is a choice, preference is given to a semi-intensive type of construction with terraces of small houses. Sometimes when there is no town near the railway centre and a considerable number of houses have to be built, a sort of railway town has been erected with schools, playgrounds, theatre, church, etc.

In view of the general economic conditions and the difficulties of reconstruction, it has been decided to accentuate the economical character of the houses which must now be built.

On the other hand, in view of the vast programme which the Ministry of Public Works has in hand, it is necessary to standardize some of the more important building elements, but it is not considered desirable to push this policy too much as this would be detrimental to the local traditions in which Italy is so rich.

7. NORWAY :

State Railways.

No details.

8. HOLLAND :

Netherlands Railways.

Sometimes houses have been built in long terraces, sometimes in small groups of houses (1 to 6) according to local conditions in the towns and country.

9. POLAND :

State Railways.

In towns, houses usually have to be close together and in the smaller places detached houses are built surrounded by small gardens. At large junctions, building estates have been erected consisting of detached houses, accommodating one or more families.

10. PORTUGAL :

a) *Portuguese Railways.*

The chief characteristics of the houses built by this Administration are as follows :

a) houses of an economical type;

b) detached houses intended to house a single employee and his family;

c) usually there are 4 rooms and a W.C. per family;

d) the number of rooms may exceed 4 in the case of very large families or higher grades of staff;

e) houses are equipped with running water and electricity wherever these services are available;

Garden cities have recently been built as it was necessary to house a large number of employees.

b) *Benguela Railway Company.*

Houses recently built for the lower grades of staff are of the semi-detached type, single-storied, surrounded by a garden bounded by a wall or hedge.

It has been decided that in the future houses shall be built with the rooms occupied by each family on two floors.

11. RUMANIA :

Rumanian Railways.

The types of houses (blocks, semi-detached or detached, etc.) vary from one place to another as they are adapted to local conditions and the site available (central or on outskirts of towns).

Owing to the present housing crisis, the minimum standards are now allowed, together with standardization of the method of construction (materials, dimensions, etc.).

The application of town-planning principles and open spaces is preferred in the case of large building estates near the towns.

12. SWEDEN :

State Railways.

The question of housing the staff of the State Railways is no longer for the most part a matter of building new houses, but rather of improving houses erected some time ago.

The most characteristic difference between old and new houses is the better utilisation of the available space, and higher standard of sanitation.

In this connection it should be remembered that domestic duties, cooking, looking after children, cleaning, etc., are the sole responsibility of the mistress of the house. Houses should therefore be designed in such a way as to make her work as easy as possible. The kitchen should be so designed that all the members of the family can have their meals there together. It must therefore be relatively large and well-lit. The small children usually sleep in the same room as their parents. To make it easier for the mother to keep an eye on her children while about her domestic duties, without having them with her all the time, the bedroom should be beside the kitchen, with a door into it from the kitchen. The wardrobes and linen-cupboard should be reached from the bedroom. According to the size of the family, the other rooms available will be used for different purposes, such as bedroom, living room, playroom, etc. There must be good access to the cellar where the food is stored from inside the house. Central heating should be provided, hot and cold water supply, W.C. and bathroom. The different rooms should have good aspects.

The question of the way houses are grouped depends on the nature of the site available. Aspect must be taken into account, and as far as possible the houses are adapted to the site and local circumstances. Each householder should have a certain amount of garden if possible.

The old system was to provide flats in station buildings usually on the upper stories, but this is no longer done, seeing that both houses and station buildings can be better adapted to their own special usage when built separately.

b) *Göteborg-Dalarne-Gävle Railway.*

The existing houses are :

— one room and kitchen . .	324
— 2 rooms and kitchen . . .	400
— more than 2 rooms and kitchen	115

c) *Nora-Bergslagen Railway.*

No details.

d) *Grängesberg-Oxelösund Railway.*

In view of the different periods at which the houses were built and the diversity of objects in view, there are a lot of different types. There are no standardized buildings.

e) *Stockholm-Roslagen Railway.*

To complete its present housing programme the Company has bought prefabricated wooden houses (« Svenska Traus ») which are erected on concrete foundations.

f) *Västergötland-Göteborg Railway.*

No details.

13. SWITZERLAND :

a) *Federal Railways.*

There are no special types of buildings or specially prepared specifications drawn up by the Federal Railways for the construction of colonies of houses.

b) *Rhaetian Railways.*

The houses available usually provide accommodation for one, two, four, six or twelve families (small detached or semi-detached houses, terraces of small houses with gardens).

14. CZECHOSLOVAKIA :

State Railways.

The type of building adopted is that of three storied blocks of flats built of brick, and as far as possible in groups in open spaces.

QUESTION 12.

What is the present housing position in your country ? Is there a housing shortage ? Describe the present position, reporting any measures in hand to remedy this shortage. In view of the fact that conditions vary from one country to another, please give the special difficulties met with in your country.

ANSWERS.

1. AUSTRIA :

State Railways.

The housing situation in the country in general is not at all good; it is most serious in the districts that suffered from the war. The shortage of habitable houses is incredible. 80 % of the railway houses near the stations were destroyed and 25 % of the other houses.

Owing to the serious shortage of building materials of all sorts, the reconstruction of damaged property is only proceeding very slowly, and it is not possible to think of building any new houses at the present time.

2. BELGIUM :

a) *National Railways.*

The housing problem is particularly serious at the present time in Belgium as in other countries which suffered from the war.

From data obtained from the National Institute of Statistics, it appears that between 1940 and 1944, 62 383 buildings were destroyed in Belgium as a result of the war.

Housing statistics for Belgium give the figure as 2 127 296 at the end of 1944.

About 3 % of the house property in Belgium was therefore destroyed (2 099 houses belonging to railway employees were completely destroyed).

The number of houses damaged amounts to approximately 250 000. In addition, there is an increase of 49 860 in the population compared with 1940.

If account is also taken of the fact that in Belgium there are 35 000 slum dwellings scheduled for clearance, it can be appreciated that the housing problem, already acute before 1940 has now become particularly serious in Belgium.

The problem so far as Belgium is concerned is therefore as follows :

1) to reconstruct damaged houses to accommodate some 250 000 bombed out families;

2) to replace 35 000 slum dwellings by suitable houses;

3) to solve the housing crisis.

— To assist railway employees, whose homes have been damaged :

The Belgian National Railways, who wish to give effective and practical assistance to bombed out employees, have created an organisation to meet the needs of those concerned.

This organisation looks after the interests of employees of the Belgian National Railways whose homes were damaged; these number about 12 000, counting only employees and retired staff who owned their own homes.

Gangs of building operative have been formed from amongst the temporary gangers to repair the damaged homes of employees under the supervision of technicians of the Belgian National Railways.

In the country as a whole, 46 co-operative societies for the repair of war-damaged homes have been set up by the Ministry of Reconstruction. The Belgian National Railways have one or more representatives on 44 of these, either as directors or commissioners. These representatives are entrusted with looking after the material and moral interests of its employees. The latter are encouraged to join the co-operative society belonging to their particular district.

As the supply of building materials increases, and those whose homes suffered war damage are able to obtain advances and loans — as it is also a question of financial means — the action taken by the Belgian National Railways will be extended.

— The Problem of Reconstruction.

The problem of reconstruction of homes is a practical one.

Bearing this in mind, the Ministry of Reconstruction has set itself two objects :

a) to take all possible steps to house those whose homes suffered damage;

b) to confirm the rights of those whose homes suffered war damage, by passing as soon as possible a law on the settlement of war damage claims.

To achieve the first of these objects, many edicts have been published, the most important of which are summed up below :

— decree on the reservation of materials (*Moniteur* of 28/6/1946), which gives the Ministry the right to reserve all home produced or imported materials for war damage repairs.

— agreement with the Italian Government concerning the employment of Italian building operatives to make good the shortage of Belgian labour;

— creation of *co-operative societies for owners of war-damaged property,* which will have a striking effect on the cost of the materials used for reconstruction; to date 48 such co-operatives have been established;

— priority for certain classes of owners, who will be the first to get advances from the State;

— introduction of a simplified procedure when claiming an advance, which will not involve a complete inventory of the damage suffered;

— speeding up the construction of 1 000 houses in the districts, which suffered the greatest damage;

— giving burgomasters and provincial officials of the Ministry the right to requisition accommodation for those who suffered war damage (*Moniteur* of the 30/6/1946);

— property-owners required to declare and advertise vacant houses and rooms in their possession (*Moniteur* of 30/6/1946).

b) *National Light Railways.*

c) *Brussels to Tervueren Electric Railway.*

At the present time, there is a very serious housing shortage in Belgium due to the great destruction that took place during the war; it will be several years before things can be expected to return to normal.

3. BULGARIA :

State Railways and Harbours.

The country is suffering from a serious shortage of building materials, in particular reinforced concrete, electrical supplies, pipes for water, zinc and copper sheet. The reason for this shortage is that all these materials used to be imported from abroad and international trade has not yet recovered from the war. The Government is taking steps to see that the first trading agreements made will be in connection with such materials, which are essential to the country.

In the past, railway houses were built of reinforced concrete and brick; in the future owing to the shortage of reinforced concrete they will have to be made of bricks and wood.

4. DENMARK :

a) *State Railways.*

b) *South Funen Railway.*

Gave no details.

5. FRANCE :

a) *Tunisian Railways.*

The present housing situation in Tunisia is nothing short of a disaster.

This new country in which towns were growing up very fast was sorely afflicted by the war; on the other hand the housing policy is such that those with capital have no interest in building seeing that the returns for the capital invested will be too low.

The crisis which was already beginning to be felt in 1939 has grown more and more serious, so that now it is practically impossible to find accommodation.

To remedy this position, the Government has introduced a housing programme, chiefly affecting the large towns under which blocks of buildings or detached and semi-detached bungalows will be erected in the garden cities which it is proposed to build.

The achievment of this programme is hindered at the present time by the lack of certain materials (iron, concrete, wood, varnish, etc.).

b) *Congo-Ocean Railways.*

There is an appreciable shortage of accommodation in two of the largest centres, Brazzaville and Pointe Noire. In spite of this all railway staff is housed by the Administration.

c) *French West African Railways.*

The housing shortage is very acute all over French West Africa, but especially at Dakar owing to the ever-increasing number of European officials and the tendency of the native population to look for higher standards of comfort in housing.

The only possible remedy is to build houses on a large scale. The shortage of building materials, which however is decreasing, hinders the carrying out of the proposed programme.

d) *Togo Colonial Railways.*

For European staff, the only accommodation is that provided by the Administration.

In the case of retired native staff there is a shortage of accommodation, which the Railway has endeavoured to overcome by erecting large buildings of the barracks type, in which employees are housed in one or two rooms according to the size of their family.

e) *Morocco Railway Company.*

There is a serious shortage of houses in Morocco, which is becoming worse owing to the emigration to this country of people from France and other countries, both during and since the war, as well as the normal increase in the native population and the practically complete stopping of all building during hostilities.

A belated start is now being made, which is especially encouraged by the Administration, in building houses for natives and Europeans.

f) *Damas-Hama Railway & Extensions.*

The housing question is a serious problem, especially in Lebanon owing to the large increase of population in the urban centres due to the influx of refugees from abroad (part of whon have settled in the country) and Syrians (owing to the political situation in their own country).

Many houses are being built, but the cost is very high so that they can only be afforded by a small minority; most of these houses are being built in the summer and mountain resorts, so they do not solve the housing problem.

6. ITALY :

State Railways.

The housing situation in Italy is critical owing to the enormous amount of destruction during the war.

Many small towns in the war zone were completely destroyed, while in many of the large towns a very large proportion of the houses were destroyed, so that the people are often obliged to live in illegally crowded conditions in the remaining houses.

At the present time, the Administration is busy repairing houses damaged during the war and rebuilding those which were destroyed.

In private industry also the work is being carried forward, thanks both to the initiative of private individuals who are rebuilding their homes with the assistance of the State, and to the direct intervention of the Civil Engineers who look after such work when private owners have not the means to do so.

At the present time, there are « Housing Commissariats » which are empowered to requisition and allocate any vacant accommodation at the request of the homeless. These « Commissariats » have no authority over property owned by the Administration which itself al-

locates available accommodation to its staff.

As regards private building, there is no new building of any importance going on at the present time, owing to the unduly high cost of new buildings which would result in excessively high rents.

7. NORWAY :

State Railways.

At the present time, there is a great shortage of houses in Norway, especially in large districts of the North, where all the houses were totally destroyed by the Germans during the occupation of the country, but the reconstruction programme is going full speed ahead.

8. HOLLAND :

Netherlands Railways.

Holland is suffering from a serious housing shortage owing to the war, especially in the war zones.

Owing to the shortage of building materials, only a very small number of houses can be built.

9. POLAND :

State Railways.

The housing position in general, especially in the capital, is very bad. In many places which suffered particularly during the war the inhabitants are obliged to live in mud huts, old sheds, and other improvised buildings. Every endeavour is being made to increase the accommodation available by erecting new buildings or repairing damaged buildings, or converting large houses into small flats.

However the shortage of building materials, especially wood, and the lack of expert builders constitutes a serious difficulty, while the absence of sufficient funds is an obstacle to the complete realisation of reconstruction plans.

10. PORTUGAL :

a) *Portuguese Railways.*

There is a very great housing shortage throughout the country. The Government and Local Authorities, however, are endeavouring to remedy this, in particular by building groups of moderately priced houses for working-class families.

b) *Benguela Railway Company.*

The increase in the European population, the starting of new families and the tendency of the native population to prefer town comforts are all factors contributing to the housing shortage, in spite of the building of many new houses; for this reason it is not possible to foresee an end to the shortage.

11. RUMANIA :

State Railways.

There is a serious housing shortage in Rumania at the present time due to the destruction wrought by the war, the influx of people in the large centres, especially the capital, the economic crisis, and the great reforms being made, as well as the shortage of building materials.

The important industrial and State undertakings are beginning to undertake the mass production of low priced houses intended for workmen and officials.

12. SWEDEN :

a) *State Railways.*

It is estimated that there is a shortage of some 40 to 50 000 houses in the towns and more important places.

During the current year (1946) about 45 000 houses were completed ready for occupation.

To overcome the housing shortage completely it would be necessary to increase the houses available in the most populated districts by about 50 000 a year during the next three or four years.

Owing to the shortage of labour and materials, the programme for the year 1947 as regards the construction of new houses has had to be limited to 45 000.

b) *Göteborg-Dalarne-Gävle Railway.*

c) *Nora-Bergslagen Railway.*

d) *Grängesberg-Oxelösund Railway.*

e) *Stockholm-Roslagen Railway.*

f) *Västergötland-Göteborg Railway.*

See the answer given by the Swedish State Railways.

13. SWITZERLAND :

a) *Federal Railways.*

There is a serious housing crisis all over Switzerland. The Confederation, Cantons and Municipalities are encouraging building by granting subsidies.

The shortage of labour and certain building materials is often the cause of the long delays in completing building contracts asked for by building firms.

b) *Rhaetian Railways.*

There is a great shortage of houses nearly everywhere, but this state of affairs will not lead the Administration to build any more houses, as it has already attained the desired end as explained in the answer to Question 6.

14. CZECHOSLOVAKIA :

State Railways.

The present housing situation is generally rather critical owing to the stopping of all building dating from the economic crisis of 1930.

The shortage of accommodation which has been chronic since that date was made even worse by the war during which 220 000 houses were damaged or destroyed.

The housing crisis has affected railway staff above all. Nearly all the most important railway stations, especially in the frontier regions, were damaged by bombing or other military operations and naturally the homes of railway staff which were near them also suffered.

The staff has been obliged to make do with very small unhygienic accommodation or else go and live in other places, sometimes as much as 60 km. (37 miles) away from their work.

The Government is endeavouring to cope with the crisis and has drawn up a building programme according to which 125 000 houses are to be repaired or rebuilt before 1948.

In conformity with the law on the repair of buildings, the first step must be the rebuilding of all damaged property, beginning with the regions and places most affected by the war. To encourage the building of new houses, the Government will assist the initiatives of all organisations, associations, municipalities, private individuals, etc., in this direction.

QUESTION 13.

Please indicate the main legislation relating to the construction of low priced and working-class houses, and the advantages derived from such legislation in the case of houses built by your Company and by Organisations for building privately owned houses.

Are there any provisions giving general protection against eviction ? If so, is the Railway excluded from these, owing to the need for housing their staff ?

ANSWERS.

1. AUSTRIA :

State Railways.

In the case of new houses the State grants a remission of taxes for 30 years. In carrying out the laws on housing development, the State on the one hand has assumed responsibility for the mortgage guarantees needed for loans from the banks, and on the other has made

the necessary capital for building available under avantageous terms by the concession of State credits.

The Railway Administration has put building sites at the disposal of the « Building Society » on a 99 years ground-lease free of charge, and also grants it municipal credits without charging interest.

2. BELGIUM :

a) Belgian National Railways.

The law of the 9th. August 1889 is the basis on which popular building in Belgium started. This law granted important tax reductions to Societies and workmen who bought or built houses and had to borrow capital for this purpose; this law was a great benefit to the working classes, but those who profited the most were the higher paid workmen, who where able to pay back the capital borrowed by monthly instalments.

In 1919, a law was passed which made radical changes concerning working class accommodation. This law made provision for the institution of a National Society and local or regional Societies for building low priced houses.

The State supplies funds to the « Société Nationale des Habitations à Bon Marché » (National Low Priced Houses Society) which is the « management » and distributes such funds amongst the approved building societies, the « executives ».

If there is any deficit due to inevitable circumstances, the State, the Province and the Commune will intervene. The Government grants premiums to individuals buying or building low priced houses.

The Savings Bank, through its Societies, grants loans to private individuals buying or building low priced houses.

Those who profit by these low priced houses are persons of moderate means, i.e. workmen as well as salaried staff whose wages or taxable income do not exceed the maximum laid down by the Royal Decree of the 30th. October 1928.

People of small means can get a low priced dwelling :

— by renting a house from an approved Society; the capital lent by the State must be repaid in 66 years; the rate of interest is 2-3 % and consequently houses must be let at rents amounting to at least 5-5.70 % of their cost price;

— by buying a house through an approved Society assisted by a premium from the State. To qualify for such a premium the person concerned must be Belgian by birth, have lived in Belgium since the 1st. January of the year previous to that in which the request is made; in addition he must require the house for his own use and not own any other house.

If the buyer has not enough money, he will obtain a loan from a Lending Society agreed by the Savings Bank for the amount lacking; this can be paid off by monthly instalments in 10-15-20 or 25 years; the borrower to cover this loan by the Lending Society must take out a life insurance with the Insurance Department of the Savings Bank;

— by building on an agreement to buy by an approved Society; houses built in this way are also eligible for the premiums granted to buyers;

— by building a house as a private individual; anyone can build a low priced house without having to resort to an approved Building Society.

These people also benefit by the State premiums under the same conditions as those laid down in the case of buyers.

Important fiscal benefits are also granted (exemption from stamp duties, from registration in the case of the majority of the deeds of the « Société Nationale des Habitations à Bon Marché », the approved societies and working-

class houses societies; reductions in the registration dues on purchase deeds by approved Societies and private individuals in the case of low priced houses and sites on which to build them; exemption for 10 years from financial contributions for all new houses the registered rents of which do not exceed a certain amount, etc.).

b) *National Light Railways.*

c) *Brussels to Tervueren Electric Railway.*

These Companies did not supply any details.

3. BULGARIA :

State Railways and Harbours.

Laws have been passed in order to facilitate the erection of low priced houses. The present regulations exempt such houses from all the communal taxes and fiscal charges provided the plans have been approved.

The following arrangements have been made to repay the capital invested in building :

— 30 % while the house is being built;

— 70 % guaranteed by mortgage for 20 years.

These facilities have not yet however been granted to the Administration, as the law relating to all undertakings has not yet been ratified.

4. DENMARK :

a) *State Railways.*

b) *South Funen Railways.*

Gave no information.

5. FRANCE :

a) *Tunisian Railways.*

At the present time no new Governmental decree has been issued to facilitate the building of low priced and working-class houses, apart from those dealing with the constitution and financing of Societies for building low priced houses mentioned in the answer to Question 7.

New houses merely benefit by a 10 years partial remission of fiscal charges.

A decree of the 1st. May 1938 protects tenants against injustified eviction. This does not apply to the Railway tenants; their houses are in fact considered to be part of their salaries and depend upon the latter, so that if the employee leaves he must give up his house.

b) *Congo-Ocean Railway.*

No reply.

c) *French West African Railways.*

There is no legislation regarding housing applicable to French West Africa.

d) *Togo Colonial Railways.*

No legislation regarding houses; the question has not yet arisen in Togoland.

e) *Morocco Railways.*

The creation as far back as 1919 in Morocco of a Property Credit Society favoured the construction of low priced, hygienic houses.

The Morocco Railways having organised since 1928 a system of mortgage loans for their staff, few of their employees have profited by the institution of this Property Credit Society.

Since 1942, when the Government Office for Housing Europeans was set up, private individuals who wish to build can ask for assistance subject to certain conditions. Up to the present no member of the railway staff has taken advantage of these facilities.

The « Dahir » of the 27th. May 1946 gives a remission of town taxes on all new houses for a period of 10 years from the 1st. January 1946.

f) *Damas-Hama Railway & Extensions.*

In Syria and Lebanon there is no le-

gislation concerning the building of low priced working-class houses. Requisitioning is in force to enable the Army and Public Services to obtain the buildings they need.

Railway staff have profited by such requisition orders.

6. ITALY :

State Railways.

Special decrees have authorised the Railway Administration to buy or build low priced working-class houses to be reserved for railway staff, by means of funds and through taxes as detailed.

The capital invested in such building must be repaid over a given period, usually 50 years.

Compulsary acquisition of land for building houses of this type may take place in the public interest.

Deeds and contracts in connection with the buying, building and management of low priced houses for railway staff as well as the houses themselves profit from special facilities as regards stamp duties, registration, mortgage, and other contributions; exemption for 25 years from municipal and provincial taxes and surtaxes on building and special property taxes.

As regards railway employees' co-operatives, in the case of the loans granted them, the State pays part of the interest on loans granted to date. Co-operatives also profit by a reduction of 75 % on all registrations of title, mortgage transcriptions and registration, rent agreements, transfer of buildings, fiscal dues and certain other Government taxes.

Contracts assigning the ownership of co-operative houses are exempt from stamp duties and only liable to reduced fixed taxes, as are those dealing with the repayment of individual loans to employees.

At the present time legislation is in force according to which all accommodation in general is controlled, i.e. eviction is impossible, unless the owner can prove very grave need; and it is forbidden to increase rents above a certain percentage fixed by law.

Railway houses are not affected by this legislation however and the Administration can if it thinks fit in the interest of the service evict employees from their homes.

7. NORWAY :

State Railways.

There is no law in Norway concerning the building of low priced working-class houses.

In the near future, however, a law will be drawn up concerning the creation of a Special Bank (Husbanken), the object of which will be to grant loans at low rates to those who wish to built their own homes.

8. HOLLAND :

Netherlands Railways.

The Government and Municipality will shoulder any deficit resulting from the building of working-class houses in collaboration with them. Capital to build such houses is lent by the Government.

These arrangements do not however apply to houses built by the Society for building houses to rent to railway employees mentioned under Question 3.

The law does not generally allow tenants to be evicted; accommodation provided by the railway in the interest of the service is an exception to this.

9. POLAND :

State Railways.

The Town & Country Planning Decree of the 2nd. April 1946 provided special facilities for buying building sites, the

purchase of which can be made compulsary.

In the case of new houses built in towns special credits may be granted.

A considerable impulse to house building was provided by decree of the 26th. October 1945 concerning the demolition or repair of buildings damaged during the war, according to which if the owner himself does not undertake the repair of the building, the State or Public Institutions mentioned in the Decree can repair and make use of it.

New houses also benefit by various facilities as regards taxes and payment.

10. PORTUGAL :

a) *Portuguese Railways.*

b) *Bengueia Railway Company.*

No details supplied.

11. RUMANIA :

Rumanian Railways.

There are no laws or regulations to protect or encourage private buildings or low priced houses. The only law concerning houses is that now in force protecting tenants whose leases have been extended since 1939 from eviction.

12. SWEDEN :

a) *State Railways.*

To encourage the building of houses, the State lends its support either in the form of « third party loans » of up to 100 % of the cost of construction, or in the form of subsidies granted to new buildings in places where the rents are at such a low level that it would not be possible to obtain a fair return on the capital invested.

Rents are regulated by a special law and are very close to those in force in 1939.

The cost of building on the other hand has increased by 30 to 40 % compared with the pre-war period; subsidies are granted by the State, however, and in certain cases by Municipalities.

The above measures do not apply to railway houses.

There is a law guaranteeing the protection of tenants but this also does not apply to accommodation occupied by railway employees.

b) *Göteborg-Dalarne-Gävle Railway.*

c) *Nora-Bergslagen Railway.*

d) *Grängesberg-Oxelösund Railway.*

e) *Stockholm-Roslagen Railway.*

f) *Västergötland-Göteborg Railway.*

These Administrations have nothing important to add to the reply given by the State Railways to this question.

13. SWITZERLAND :

a) *Federal Railways.*

Each of the 25 Cantons or « demi-cantons » has its own legislation regarding buildings. There are also many Communal regulations. These also apply to both the Federal Railways and Railway Employees Building Co-operatives.

b) *Rhaetian Railways.*

There is no special legislation concerning the building of houses for railway employees.

14. CZECHOSLOVAKIA :

State Railways.

The construction of blocks of small flats should be facilitated by the new law which is being passed to encourage building.

The law protecting tenants protects them against the termination of their leases.

The law in connection with special measures concerning the use of housing, which is only valid up to the 31st. De-

cember 1948, lays down that accommodation put at the disposal of State employees (railwaymen) in other Communes must be allocated to other State employees (railwaymen) if they are moved.

The same law also authorises the reservation of the necessary accommodation for certain groups of persons whose sojourn in the Commune is necessary in the public interest (consequently also covering railway employees).

QUESTION 14.

Please give a brief history of the past building programme achieved either by the Railway or by Societies created to build private houses, indicating :

a) *The number of employees of all grades, employed by the railway;*

b) *Percentage of such employees living in houses belonging to the Railway and those housed in private property. Percentage of employees who are still waiting to be housed by the Company in order to assure the regular working of the railway;*

c) *Total number of buildings, flats and rooms; the latter to be estimated by counting in addition to the rooms in each flat half a room for cellars and half a room for attics, and as one room the whole of the offices (hall, toilet, bath, boxroom, etc.);*

d) *Number of houses belonging to the railway occupied at the present time by railway employees;*

e) *Number of houses belonging to the railway occupied at the present time by retired railway employees or their widows.*

ANSWERS.

1. AUSTRIA :

State Railways.

The total number of staff is now about 100 000, but it will be much lower when those redundant to operating requirements are released.

The Company is not able to give the other details asked for owing to the destruction of the archives during the war.

2. BELGIUM :

a) *Belgian National Railways.*

a) Number of staff (as at 1st. November 1946) :

Permanent and provisional workmen	54 540
Permanent officials and employees	18 694
Total . .	73 234
Temporary workmen	15 560
Temporary employees	4 206
Total . .	19 766

b) 1. Percentage of permanent staff living in houses belonging to the Company : 5.2 % of the total staff.

2. Percentage of permanent staff owning their homes : 60 %.

3. Percentage of employees still to be housed in accommodation provided by the Company to assure regular services : 0.5 % of the total number, i.e. 366 employees.

c) The number of houses belonging to the Belgian National Railways built in the past amounted to 5 201 on the 1st. January 1946.

Nearly 4 % of these houses were destroyed during the war.

Percentage of number of houses belonging to the Belgian National Railways now occupied by other than railway staff : 22 %.

Percentage of staff housed in accommodation provided by the National Railways for reasons other than service reasons : 15 %.

	No. of houses occupied by railwaymen.	*No. of houses occupied by other persons.*	*No. of houses destroyed or rendered uninhabitable.*
1) Houses in the stations and alongside the permanent way .	3 551	781	168
2) Building estates and garden cities	324	347	30
Total . .	3 875	1 128	198

b) *National Light Railways.*

c) *Brussels to Tervueren Electric Railway.*

See the answer to Question 1.

3. BULGARIA :

State Railways and Harbours.

During the second world war the building of houses for railway staff came to a standstill; building was recommenced in 1945, but there were a lot of difficulties in the way, due above all to the shortage of building materials.

The number of railway employees is 36 107.

The percentage of employees housed by the Railways is 15 % of the total. The others live in private houses.

The percentage of employees housed by the Administration who must always be available for duty is 75 %. Some 25 % must still be lodged in houses belonging to the Railways to assure the regular working of the services.

The total number of dwellings situated in building belonging to the Administration was 5 204 in 1946. All these are occupied by employees actively concerned with the operation of the services.

4. DENMARK :

a) *State Railways.*

The Administration owns about 3 000 houses, nearly 500 of which are occupied by private individuals as they are not required by railway employees.

b) *South Funen Railways.*

No details.

5. FRANCE :

a) *Tunisian Railways.*

The number of staff of all categories employed on the railway at the present time is about 6 500, of which 4 000 are permanent employees, the remainder being temporary or seasonal staff. When the Railway has been modernised, it is estimated that only 3 000 permanent employees will be required.

Temporary and seasonal employees find their own accommodation.

Of the 4 000 permanent employees, about 650, or 16 % are housed by the Railway; the others find their own accommodation in private houses.

To assure the regular working of the Railway, it is necessary to be able to provide accommodation for 3 000 employees, either in the Railway buildings or outside. This was possible 20 years ago when private individuals were building houses to rent in Tunisia; it was already difficult in 1939 when building had slowed down; at the present time it is quite impossible.

Houses must be built. It is certain on the other hand that no houses will be built until the present legislation has been radically modified (for example the

rents must cover the capital invested, which will lead to an increase in wages; heavy industries and administrations will have to house a certain number of their workmen or employees; government financial facilities must be made available, etc.).

As regards the railways, the shortage of housing makes it very difficult to recruit the necessary technical and supervisory staff; it also makes it difficult to move employees about.

Consequently, if no Governmental steps are taken within the next year or two, the Railway will have to consider building houses for its staff; taking into account the number of staff already housed by the railway, together with those living in their own homes and those accommodated elsewhere, the first stage will be the provision of about 500 flats.

The total number of buildings available for accommodating the staff is 600, comprising 891 dwellings and 2 574 rooms.

These dwellings are all of the detached or semi-detached bungalow type, apart from the accommodation provided in the stations, which is usually on the first floor of the passenger station buildings.

At the end of the war the Railway had to rent several houses (about 60) to accommodate their staff; these were in general premises which had been partly destroyed and which the Administration repaired by agreement with the owners.

There are no houses occupied by retired employees or their widows. Every now and then individual cases of hardship arise which the Administration tries to remedy as quickly as possible.

b) *Congo-Ocean Railway.*

The number of staff of all categories employed on the railway is about 100; they are all housed by the Railway.

c) *French West African Railways.*

The table (p. 336) sums up the answer to this question.

d) *Togo Colonial Railways.*

Number of staff af all grades employed on the railways : 33 Europeans. Number of houses belonging to the railway occupied by employees : 24, 5 of which are of a temporary character. No house is occupied by retired employees or the widows of employees.

e) *Morocco Railways.*

Number of staff of all categories : 2 400 Europeans, 781 of which, i.e. 33 % of the total staff, live in houses belonging to the Company; 59 % are housed in private houses, and 8 % are waiting for houses.

The Company has built 466 dwellings of the bungalow type in the most important railway centres :

— two blocks for batchelor members of the staff, with a total of 47 rooms;

— 83 dwellings in the passenger station buildings;

— 185 houses for permanent way superintendents alongside the permanent way.

All this accommodation is occupied.

f) *Damas-Hama Railway & Extensions.*

No details supplied.

6. ITALY :

State Railways.

Since it was instituted the Administration has endeavoured to make it possible for the lower paid grades of staff to live in service houses in the places where they have to live on account of their work.

By a special law passed in 1907, the railway was authorised to use part of the excess funds of the « Pension & Staff Benefit Fund » up to a sum of 30 millions to build and buy low priced houses for its staff; a subsequent law passed

Place.	*No. of staff of all grades.*	*Staff housed.*	*Staff not housed.*	*No. of buildings.*	*No. of flats.*	*No. of rooms.*	*No. of houses occupied by employees in service.*	*No. of houses occupied by retired employees or widows.*
Dakar-Nigeria (Senegal-Soudan)	1 367	520	847	Small blocks of flats. 59	157	532		
				Semi-detached bungalows. 123	246	864	520	
				Detached bungalows. 117	117	596		
Conakry-Nigeria (French Guinea)	259	79	180	Small blocks of flats. 2	7	48		
				Semi-detached bungalows. 4	8	32	79	
				Detached bungalows. 64	64	317		
Abidjan-Nigeria (Ivory Coast)	430	140	290	Small blocks of flats. 12	38	147		
				Semi-detached bungalows. 36	72	252	140	
				Detached bungalows. 30	30	130		
Benin-Nigeria (Dahomey)	106	106	—	Small blocks of flats. —	—	—		
				Semi-detached bungalows. 24	48	144	106	
				Detached bungalows. 58	58	180		
Transport Management	78	27	51	Small blocks of flats. 4	22	82		
				Semi-detached bungalows. —	—	—	27	
				Detached bungalows. 5	5	20		
TOTAL	2 240	872	1 368	Small blocks of flats. 77	872	3 344	872	
				Semi-detached bungalows. 187				
				Detached bungalows. 274				
				538				

in 1913 authorised up to 50 millions to be borrowed from the above fund for this purpose.

However, the approved programme for building new houses had hardly been begun when the war broke out and all such work had to be suspended.

When the war was over the builders started work again and the Railway Administration had to meet a huge increase in the cost of labour and materials.

A new law authorised the borrowing of a further 30 millions to carry out the building programme, which sum was also borrowed from the above fund. Even this proved insufficient however, and in addition in view of the housing shortage in Italy as everywhere else after the war, it was necessary to extend the original programme. Successive decrees authorised the borrowing of additional sums from the above fund as well as those of the Savings Fund, so that these amounted to some 500 000 000 lire. In building these houses the Administration also used part of the funds allocated by the Treasury for work carried out to increase the capital assets of the railway.

Finally, in connection with the housing crisis and side by side with general Government legislation passed in order to stimulate private initiative in building working-class and low priced houses, the Railway Administration in order to assist to a greater extent in solving the important problem of housing, encouraged the creation of many railway co-operatives to build houses for private ownership, by assuring that the necessary means were available for carrying out their programme.

The number of staff of all grades employed by the Administration on the 31st. August 1946 was 178 832.

The percentage of employees now living in houses belonging to the Administration may be estimated at 27 % when all such property has been repaired.

The building co-operatives for private ownership have built about 5 500 dwellings, but many of the employees to which these were allocated have since retired, whilst others have sold them to private individuals, others have died, and the houses have been taken over by their heirs.

The special grades of staff who are entitled to live in the railway's « patrimonial » houses, gatehouses or apartments in property near railway installations have been accommodated for the most part, and it can be stated that all those who must be housed for the good working of the system have been housed.

The following table shows the number of dwellings and rooms for the various kinds of houses, the kitchen being counted as one room, but other domestic offices being excluded :

	« Economic » houses.	*« Patrimonial » houses.*		*TOTAL.*
		Dwelling houses.	*Gatehouses.*	
No. of dwellings	13 855	15 162	19 975	48 992
No. of rooms	47 280	56 520	59 091	162 891

All the « patrimonial » houses are occupied by employees with special responsibilities.

Nearly all the « economic » houses are occupied by railway employees with the exception of a very small percentage still occupied by retired employees or their widows; this percentage will continue to decrease as the railway takes care to see that those who are no longer entitled to them, give up such houses as soon as possible.

The gatehouses are also occupied in some cases by private individuals, who are responsible for the maintenance work along the permanent way.

7. NORWAY :

State Railways.

This Administration was not in a position to give any details on this subject.

8. HOLLAND :

Netherlands Railways.

The number of employees of all categories employed by the Railway Administration amounts to 40 200, only 4 % of which are housed by the Administration; 95 % live in private dwellings. The percentage of employees still to be housed by the Administration is about 1 %.

The total number of dwellings occupied at the present time by railway employees is 1 500; 25 dwellings are occupied by retired employees and 10 by employee's widows.

9. POLAND :

State Railways.

At the present time the Railways employ a staff of 261 019. Before the war the Railways owned 14 828 000 m^3 of accommodation, 3 398 000 of which was destroyed during the war.

They are not in a position to supply the other information asked for.

10. PORTUGAL :

a) *Portuguese Railways.*

Total number of employees : 21 500, 19.5 % being housed by the Administration and 51 % in private houses.

In order to assure the proper working of the railways, it is necessary to house a further 27 % of the above staff in railway accommodation.

4 190 dwellings are occupied by employees.

No dwellings are occupied by retired employees or employee's widows.

b) *Benguela Railway Company.*

This Company supplied no information.

11. RUMANIA :

Rumanian Railways.

The supplying of accommodation has always been a problem for the Rumanian Railways.

Number of employees of all grades : 150 000, 40 000 of whom work in Bucarest.

Percentage of employees living in railway owned accommodation : 1.5 %.

Percentage of employees who should be housed : 20 %.

Before the war the Administration owned 3 572 dwellings, 1 235 in Bucarest and the neighbourhood, 70 % of which were destroyed or seriously damaged by bombing.

Since the 23rd August 1944, 944 houses have been made inhabitable in the centre of Bucarest, which was the most seriously affected, and 800 bombed out employees and their families were acccommodated.

During 1946, 186 flats were built.

During 1947, the Assistance Board proposes to build 600 flats in Bucarest and 788 in the provinces.

It is not possible, actually, to give any exact figures concerning the number of

dwellings occupied by employees, retired employees, widows, etc., in the different districts.

12. SWEDEN :

a) *State Railways.*

The number of employees of all grades employed on the State Railways was 59 500 on the 31st December 1945.

The other details asked for cannot be supplied.

b) *Göteborg-Dalarne-Gävle Railway.*

Total number of employees : 4 189 about 19 % of whom are housed by the Administration :

	No.
Buildings	528
Dwellings	839
Rooms	3 200

Number of dwellings occupied by employees : 811. 28 dwellings are occupied by retired employees and widows.

c) *Nora-Bergslagen Railway.*

Total number of employees: 210, 37 % of whom live in accommodation belonging to the Administration.

	No.
Buildings	66
Dwellings	80
Rooms	240

Dwellings occupied by employees : 79

d) *Grängesberg-Oxelösund Railway.*

Total number of employees : about 1 400, 30 % of whom are housed by the Administration.

	No.
Buildings	250
Dwellings	550
Rooms	2 500

Dwellings occupied by employees : 450; by retired employees and widows 100.

e) *Stockholm-Roslagen Railway.*

Total number of employees : 710, 19 % of whom live in houses belonging to the Administration and 81 % in private houses.

No. of buildings	145
dwellings	152
rooms (not counting kitchen)	390

No. of dwellings occupied by employees : 135.

Dwellings occupied by retired employees or widows : 14.

f) *Västergötland-Göteborg Railway.*

Total number of employees : 727, 44 % of which are permanent staff.

Employees housed by the Company : 92, or 12.65 % of the working staff.

Houses built by the Administration :

Position.	*No. of buildings.*		*No. of dwellings.*	*No. of rooms.*
	Blocks.	*Detached. bungalows.*		
Towns	2	7	11	34
Outskirts	—	8	8	20
Country	4	66	74	177
	6	81	93	231

They are all occupied by railway employees with the exception of one three-roomed dwelling.

13. SWITZERLAND :

a) *Federal Railways.*

The number of railway employees is about 32 000, 2 400 (8 %) of whom live in service houses and 200 (0.7 %) in accommodation rented from the railway. The service houses are sufficient in number to house those employees who for service reasons must live near their work.

No accommodation is occupied by retired employees or the families of deceased employees.

b) *Rhaetian Railways.*

Total number of employees : 1 261.

33.3 % live in accommodation provided by the railway; 66.7 % are housed in private dwellings.

151 buildings in passenger stations and gatehouses for keepers have been built, giving a total of 187 dwellings, with a total of 1 047 rooms, and 74 buildings providing 234 service dwellings with a total of 1 212 rooms.

14. CZECHOSLOVAKIA :

State Railways.

Since the creation of the Republic of Czechoslovakia, the Railway Administration has done its best to house all its employees. In the first few years, the main concern was to get hold of accommodation that could be used at once.

Then the Administration began to build houses itself, and between 1918 and 1937, 377 houses were erected, accommodating 4 143 families.

After this period, up to 1942, i.e. during the forced interruption of the war, 55 houses were built in 25 Communes, accommodating 762 families.

The total number of employees is 190 000.

13 % of these employees are housed by the Railway, 54 % live in privately owned houses, and 33 % have still to be accommodated in houses belonging to the Administration, to assure the regular working of the railway.

Dwellings built total 25 105, all of which are inhabited by railway employees.

It is very rare to find retired employees or widows living in railway accommodation, and in any case they would only be allowed to do so for a short time.

III. SUMMARY OF THE REPLIES RECEIVED FROM THE DIFFERENT RAILWAYS.

1. The reasons which have led Railway Administrations to build houses for their lower grades of staff or to assist them to build houses are the following :

— Necessity of housing the staff on the job.

This applies to staff whose duties concern the safety of operation and who consequently must live near their work; with this object in view accommodation has been provided in the stations, near sheds, shops and other installations of this sort, as well as along the permanent way.

— Necessity of having sufficient accommodation available in places where the housing shortage is worst.

— Possibility of transferring staff without delay whenever this is necessitated by service requirements.

The Railways in the African Colonies in general house all their European staff, chiefly on account of the special service conditions and the general necessity for housing staff coming from France to a colony where suitable housing accommodation is lacking. Accommodation is only allocated to the native staff for service reasons.

Other Administrations act differently, according to the housing position in their respective countries. Thus certain Railways only provide accommodation for those categories of staff who must live near their work. Others have also built houses for other categories, who were unable to find accommodation in private houses for themselves.

Finally, certain Administrations either on account of the small size of their system or because of the existence of special organisations for housing workingmen in their country, have not considered it either advisable or necessary to build houses for their staff, except for a few employees, who are responsible for the regular operation of the system.

The final object of building houses for the staff is to obtain the most rational and advantageous use of the staff which is essential if the railway services are to fulfil the desired object.

2. The accommodation provided may be divided into two kinds according to user :

— Service houses, located in station buildings or near them, as well as in sheds, shops, or other installations, and alongside the permanent way, which are allocated to employees who must be available for duty at all hours (stationmasters, chief pointsmen, foremen gangers, platelayers, shed superintendents, permanent way superintendents, crossing-keepers, technical foremen, etc.).

On the Italian Railways, this type of house belongs to the category known as « patrimonial » houses, as they are built with the assistance of funds supplied by the State for work which will increase the capital assets of the Administration.

These houses are allocated according to service requirements; on some Railways no rent is charged for them.

— Houses for all employees other than those mentioned above, who are unable to find private accommodation.

Such accommodation is usually allocated according to the financial and family situation of the employee concerned. Service interests are not overlooked, however, whenever it is question of employees whose duties are of such a nature that they must always be available on call although they are not obliged to live on the job. In general such accommodation is rented, except in certain Colonies where, as has already been said, all the staff is housed rent free.

Under this category come the so-called « economic » houses of the Italian Railways built by sums borrowed from the « Railway Staff Pension & Benefits Fund » and « Savings Fund », as well as « patrimonial » houses built for workmen and employees in places where it would be difficult for them to find suitable accommodation, which in this case are considered as additions to the above mentioned « economic » houses.

3. Certain Administrations in order to normalise the housing position for their staff as quickly as possible, owing to the difficulties caused by the war or other circumstances, have not only build houses themselves but also bought or rented private houses, even damaged houses which they have put into good repair by agreement with the owners.

In addition, to encourage building, they have created special organisations responsible for building houses to be rented to the staff, and supplied them with all the means necessary to do so (allocations of building loans, either from State or Communal funds, supplying sites, etc.). The repayment of capital invested in such building is regulated in various ways, usually over a period of years up to 50 years.

Mention may be made here of the method adopted by the Czechoslovakian Railways to supply the Railwaymen's Housing Organisation with the necessary funds. To start with they are given

certain securities to enable them to obtain short term loans and all they require for starting to build. As soon as the building is completed, a long term mortgage is taken out, which releases the securities again for the building of more houses.

4. Concerning the formalities and conditions under which the necessary funds for building staff houses are supplied, different methods are used on different Railways. A distinction may be made between the following cases :

— Houses built by means of sums included in the general railway budget; capital repaid with a given period (30-50 years); in certain cases no sinking fund provisions are made owing to the lack of any separate management.

— Loans for building houses for staff not required to live in service houses, granted by the « Pensions & Benefits Funds » of the railway staff, which must be repaid over a given number of years.

— Houses built by special loans granted to the Railway by the State and repaid over a certain term of years.

— Houses built by means of loans from private lending societies, repayable over a given term of years.

Thus on the Italian State Railways the necessary funds for building « patrimonial » houses are granted by the Treasury at a given rate of interest for a given period varying from 30 to 50 years during which the capital must be repaid to the Treasury by successive repayments, whereas the « economic » houses are built by funds borrowed from the « Staff Pensions & Benefits Funds » and « Savings Funds » at a given rate of interest; the Administration includes in its budget each year the amount necessary to pay off the capital loan in 50 years, and the tenants do not have to make any contribution towards this.

The following table gives certain details concerning the cost of building houses on the different railways; this table brings out very clearly the great rise in building costs during and since the war.

Rents are determined as a general rule on the following basis : in places where there is no housing problem, rents are so determined as never to compete with those charged by private individuals for similar accommodation in the same place; on the other hand, in places where the housing position is bad, and the cost of building very high, as in most of the countries under consideration, a suitable rebate is given.

Rents fixed in this way are obviously lower than those that would have to be charged to meet the interest and repayment of capital invested in the building and the cost of upkeep and management, so that the railway has to contribute towards the cost. Various steps have been taken in this connection. Some Railways pay part of the rent, in certain cases up to 100 % of the amount paid by the tenant; other Administrations contribute by paying part of the interest due on the capital invested in the building.

When staff is housed by the Railway in accommodation rented from private individuals, the custom is to charge only the current railway rents, any difference being paid by the Administration.

5. In principle, retired employees and the widows or families of deceased employees must give up railway houses so that these can be reallocated to employees in the actual service of the railway; the houses must be vacated within a reasonable time. Exceptions are sometimes made to this rule for humanitarian reasons, always provided this does not affect any service requirements. Certain Administrations regulate such tenancies by granting a lease at the usual rent.

In Rumania, at the present time retir-

Country.	Year built.	Type of building.	Average cost per room.		Average cost per m³ of building.	
			Local currency.	Fr.	Local currency.	Fr.
Austria.						
Wiener-Neustadt	1938-1939	Large blocks.	RM. 2 500 (1)	37 830	RM. 32	484
Mödling	1931	Detached & semi-detached bungalows.	S. 13 000 (1)	45 210	S. 200	695
France.						
Tunisia	1946	Semi-detached bungalows.	...	...	—	2 500
Dakar (Senegal)	1946	Semi-detached or detached bungalows.	...	210 000 (3)	—	5 000
Conakry (Guinea)	1946	»	...	191 625 (3)	—	4 570
Togo	1946	Detached bungalows.	...	200 000 (3)	—	—
Morocco	1946	Large blocks.	...	96 000	—	1 715
Morocco	1946	Small blocks.	...	128 000	—	2 285
Italy (4).						
Turin	1923	Small blocks.	L. 19 810	15 010	L. 143	108.2
Turin	1930	Large blocks.	10 165	13 550	—	—
Milan	1921	»	13 800	7 943	137	78.2
Milan	1930	»	7 800	10 400	—	—
Bologne	1923	»	7 790	5 220	75	56.7
Rome	1923	»	15 570 (1)	11 794	158	112
Rome	1933	»	10 800	14 362	—	—
Rome	1940	»	11 950	27 790	—	—
Rome	1942	»	22 000	57 894	—	—
Rome	1943	»	32 400	85 289	—	—
Napoli	1922	»	12 722	7 356	110	63.5
Poland	1946	Large & small blocks.	Zlotys 200 000 (1)	105 263	Zlotys 2 500-3 000	1 315-1 579
Sweden.						
Valentuna	1946	Semi-detached bungalows.	Cr. 5 000 (1)	166 315	Cr. 110 (2)	3 658
Czechoslovakia	1946	Small blocks.	Kcs. 20 000 (1)	47 032	Kcs. 160	376

(1) Actual rooms including kitchen, but not counting domestic offices.

(2) Excluding cellars.

(3) In addition to rooms properly speaking and the kitchen, counting cellars and attics as half a room and the whole of the domestic offices as one room.

(4) The new programme for buying or building houses is as follows:

Place :	Approximate average estimated cost per room :	
	L.	Fr.
Milan	280 000	147 368
Bologne	150 000/155 000	78 947/ 81 578
Rome	240 000/320 000	126 315/168 421
Naples	215 000/280 000	113 157/147 368

ed railway staff profit by the law which prevents any tenant from being evicted.

On the African Railways, European staff are housed during the whole period of their employment in the colony; retired employees and the widows and families of deceased employees do not remain in the Colony but are sent back to France.

As regards native staff, these profit by the general measures concerning native employees.

The Czechoslovakian State Railways intend to build special homes for old retired employees.

6. Several Administrations are engaged at the present time in rebuilding houses seriously damaged or destroyed during the war; such buildings, usually situated near stations, suffered much more severely than private houses.

The objects aimed at by the Administrations in building staff houses differ from one railway to another. There are two main tendencies : in one case the object will be considered as attained when it is possible to house all employees who must live near their work; in the other the aim is to build houses for all the staff.

The considerations, on which the two tendencies are based, are due to the general housing position in the country concerned, so that in places where it is extremely difficult to find accommodation the railways think the problem will only be solved when all the staff can be housed.

Not all the Railways consider their aims have been achieved; on the contrary some of them agree that they are further off than in 1939 owing to the destruction caused by the war and other factors, such as the concentration of refugees in the main town.

They have decided to proceed with the construction of new accommodation and if needs be have drawn up programmes, some of which are already in course of completion.

Details concerning these building programmes will be found in the answers sent in by each Administration.

The completion of these programmes in many cases depends on several conditions, such as the availability of building materials, tools, etc.; in addition certain other Administrations have not yet been able to make a start owing to the excessive cost of materials and labour.

A special situation arises on the Belgian National Railways which has had to let 22 % of the accommodation provided to other than railway employees, since most railwaymen do not like to live in the accommodation provided by the Company at their place of work but wish to own their own homes, which they like to build where and how they please. Consequently, the Company does not intend to provide houses for all its staff but rather endeavours to assist employees to buy the houses they want. At the present time 60 % of staff own their own homes.

7. Certain Administrations have assisted their staff to buy or build houses by special arrangements made in conjunction with the general measures adopted by the Government to solve the housing crisis. intended to give both railwaymen's co-operative building societies and individual employees the necessary means to build their own houses.

The above mentioned Societies as well as individual employees are able to make use of the following advantages :

— Allocation of mortgage loans at a suitable rate of interest repayable over a long period, either directly from the State or the Railway itself (some of which have used the resources of the Staff Pension and Benefit Funds for this purpose) or by Lending Societies.

Loans are usually granted up to a

certain percentage of the value of the property (on the average 70 %).

— The State or Administration concerned will help with the cost of building or in paying the interest on the capital invested in the building.

Facilities of all sorts are given for buying building sites as well as for the transport and supply of building materials.

Amongst the Administrations, which have done the most to encourage the building of individually owned houses, mention may be made of :

— The Belgian National Railways which have created two companies who will give mortgage or short term loans to railwaymen to enable them to buy or build houses of the type known as « low priced houses ». These companies which get the necessary capital, one from the « General Savings Bank » and the other from the National Railways themselves, granted a total of 3 913 mortgage loans and 459 short term loans between 1930 and 1939.

About 60 % of the staff have become house owners, with or without the aid of the National Railways.

— The Morocco Railways which before the war granted 156 mortgage loans for the building of as many houses to be privately owned by the staff (these will house about 7 % of the staff).

— The Italian State Railways which in the years 1921 to 1928 supplied or procured the necessary capital required by the many railway staff building cooperative societies for building 5 470 privately owned dwellings, housing about 3 % of the staff.

— The Swiss Federal Railways who granted 1 400 mortgage loans to individual employees between 1909 and 1945, up to 2/3rds. of the value of the property, as well as supplying the necessary capital to 26 railwaymen's cooperative building societies to enable them to build 1 173 dwellings; in this way a total of 2 573 dwellings have been built, which will house about 8 % of the staff.

If the above have helped to solve the housing crisis in the countries concerned, they have not on the other hand been efficacious in solving the housing problem for the railways themselves; as these are all privately owned houses, the Railways cannot allocate them, but in the end they will no longer be occupied by railway staff as they may be bequeathed or sold to other persons.

As for the effects of private ownership of homes on the service, certain Administrations are of the opinion that this cannot be any obstacle to the railway service except in the case of employees whose duties mean that they are frequently moved from place to place. On the contrary in the case of employees who normally remain in the one place, they contribute to the efficiency of their work since the employee is better off and the service no doubt benefits thereby.

Other Administrations express the opinion that the possible objection of employees living in their own homes to transfer or possible promotion, will not be any obstacle to the service, as ordinarily there are always plenty of candidates for the vacant posts.

However, if the Administration has sufficient accommodation available for all its staff, the case of employees refusing to give up their own homes will be very rare; moreover those concerned cannot afford to overlook the consequences likely to follow on their refusal to move when ordered to do so by their superiors.

The French West African Railways point out that the possible purchase of homes by the African staff will not hinder the services seeing that transfers of staff are extremely rare for racial and political reasons.

8. The construction, upkeep and management of staff houses are generally in the hands of the technical departments of the railway itself. Such departments, according to the different organisations, are known as « Works Department », « Plans and Buildings Department », « Technical Permanent Way Office », « Permanent Way and Buildings Department », « Building Department », « Office for the Erection of Buildings », etc.

Certain Administrations have the more important building programmes carried out by private firms.

Buildings erected by special societies created by the railways for building houses for railway staff are maintained and managed by such societies themselves.

In addition various Railways have created special offices to co-ordinate the activities of the above mentioned organisation and to make provisions of a general character.

Accommodation is allocated by special Committees on which the staff is represented.

As regards individually owned houses built through co-operative societies, the Railways merely exercise a general supervision either through the above mentioned organisations or through offices, committees or societies formed for this purpose.

9. As regards the financial effects of building and managing houses for the staff on the railway budget, it should be pointed out that certain Administrations have set up independent managements for this purpose; others on the contrary consider the building involved in providing houses as part of the other constructional work of the railway, so that this is directly included in the railway budget.

In this connection it would be interesting to know the value of the effects of the cost of housing the staff on the total operating costs; for the French West African Railways for example these expenses are about 15 % of the total.

Certain Railways in countries where the rents are very high, point out that the expense of housing the staff is no more than it would cost to increase wages to enable the staff to pay the rents in force.

Administrations with a separate staff housing department point out that in most cases this is run at a loss, and are of the opinion that the main causes of this must be sought in the considerable increase in the cost of upkeep of buildings and management costs which are not made good by a corresponding increase in the rents, since these must necessarily remain within the limits imposed by the restricted means of railway employees, the financial position of whom has deteriorated during these last years.

These deficits affect the railway budget.

In the case of the Austrian State Railways the cost of housing the staff is the amount that must be paid to the organisation set up to build such accommodation to reduce the excessive rents due to the high cost of building.

The Belgian National Railways who have appointed special societies known as « Lending Societies » to deal with the cost of administering and managing houses for railway staff, has no financial obligations to meet owing to the existence of such societies. They are paid by the dividends received for their share (shares subscribed) and by fixed interest on capital advanced.

In general, it is recognised that the deficits in question are a result of the upset due to the war, and consequently they will not be eliminated until things have gradually returned to normal.

10. With the exception of Czechoslovakia and certain parts of Africa, there are no Government or Municipal houses reserved for railway employees.

In Czechoslovakia, the railway staff may benefit by the allocation of houses built by the State itself; these are not very numerous however.

The Togo Railway Company points out that all the houses built for lower grades of staff are in fact Government houses seeing that the railway forms part of the local administration; these houses, however, as they were built by sums provided by the railway budget, are only available for railway staff.

11. In building houses for the staff, the following types of building have been adopted :

— Blocks of several stories, with one or two flats on each floor, which may be classified as large or small blocks according to the number of stories and the number of flats per floor.

— Semi-detached or detached bungalows, with adjoining land used as kitchen garden or garden, which usually consist of 4 rooms at the most, not counting the kitchen and domestic offices (veranda, bath, W.C., boxroom, etc.); there may be one or two stories. In Tunisia, it is the custom to build a wash-house and hen-house near the house.

— Small semi-detached houses, each for the use of a single family, usually two storied (ground floor and upper floor); each house has its own garden; they are similar to the bungalows as regards the number and size of rooms.

In the more important centres, the railwaymen's houses often form a considerable proportion of the town; in such cases the layout of the buildings is decided by the town plan and blocks of flats are the most usual type of construction.

Buildings alongside the permanent way and in the small stations are usually detached or semi-detached bungalows or small blocks of flats.

Sometimes, when there is no town near a railway centre and a considerable number of houses must be built, building estates or garden cities are built consisting of groups of blocks of flats or detached and semi-detached bungalows, in which all the buildings are surrounded by open spaces laid out as gardens.

Certain Railways no longer provide accommodation in station buildings, as they find that the special requirements of each type of building are better met by having separate buildings for each purpose.

As regards methods of building, the following special methods have been reported :

In Tunisia, before 1939 dwellings were usually made of stone with tiled loft and roof. After the war, however, owing to the shortage of wood and iron, it has been necessary to roof houses with « Rhorfas » which is a 35 cm. thick arch consisting of a semicircular arch made of hollow bricks pugged with plaster and laid flat without any wooden framing on which a layer of flat 10 cm. stones is laid pugged with fatty lime; this foundation is then covered with a 5 cm. layer of concrete and a thick layer of fatty lime completes the roofing.

This type of roofing has the following advantages :

— bricks pugged with quick-setting plaster make it possible to erect a thin self-supporting arch without wooden framing;

— the use of fatty lime prevents the formation of a lot of little cracks which make the structure porous;

— finally this thick semi-circular roof improves the house by keeping it cool in summer and warm in winter.

Full details of this method of con-

struction have been given in the answer to Question 11, together with a description of the improvements recently made in this method of building.

In Tunisia, in view of the great atmospheric humidity as well as the daily and seasonal variations of temperature light construction is impossible; walls and roofs must have high calorific inertia and ventilation must be carefully planned;

The methods of construction most widely used are as follows :

— walls of stone, brick or concrete;

— ceilings in concrete or plastered iron or brick;

— roof tiled, or metal or concrete sheeting on a wooden frame;

— a framework of reinforced concrete is generally employed in countries where there are earthquakes.

Owing to the general economic conditions and the difficulties of reconstruction, it has been decided to accentuate the economical character of the houses built, and standardisation of some of the more important parts is proposed (windows, doors, water and electricity fittings, etc.).

The Swiss Federal Railways are now engaged on improving old dwellings which do not conform to modern standards; such work aims at obtaining better utilisation of the available space, taking the nature of each room into account, as well as improved sanitation.

The Stockholm - Roslagen Railway (Sweden) has bought prefabricated wooden houses which are erected on concrete foundations.

12. There is a serious housing crisis in nearly every country owing to the destruction caused by the war.

In certain countries other circumstances have also contributed to this crisis, such as the fact that in French West Africa, Morocco and Benguela, there has been an increase in the number of European employees and the natives are showing a tendency to look for Western standards of comfort in housing; in Lebanon there has been an influx of foreign refugees, many of whom have taken up their abode in the country, as well as of Syrians, owing to the political situation in their own country.

In districts ravaged by the war, the position is particularly serious; many small towns were completely destroyed and in many of the large towns the destruction of living accommodation was extremely great. Over a great part of Northern Norway, all the houses were completely destroyed by the Germans during their occupation of the country; it is the same in many parts of Poland owing to military operations and the wanton destruction wrought by the enemy; in this country the inhabitants have to live in huts, barracks or other provisional shelters.

The housing shortage has affected railway employees to a special extent owing to the destruction of a large number of their homes, which were usually situated near the railways; in certain places, 80 % of these were destroyed compared with a percentage of only 25 % in the case of other property.

To remedy this situation the Government has taken steps to speed up as much as possible the repair and reconstruction of houses damaged or destroyed during the war, as well as encouraging private initiative in building, by granting special facilities (financial subsidies, etc.).

Mention may be made of the fact that public institutions are allowed to repair and make use of buildings abandoned by their owners, as well as the fact that house owners must publish details of any vacant flats and rooms they have.

The Railways on their side are doing everything possible to solve the housing problem for their staff; however, in

many countries building and reconstruction are only proceeding very slowly owing to the serious shortage of building materials, which will only end with the recovery of international trade.

In Bulgaria, owing to the lack of reinforced concrete, houses have had to be built of brick and wood. Another obstacle to building is the shortage of skilled workmen and technicians, as well as lack of financial resources.

The shortage of labour is due above all to the housing shortage or the shocking living conditions in those still available, which leads workmen to prefer to live in places where there are better housing prospects.

Finally, it must not be forgotten that private individuals unless protected by suitable legislation on the part of the State have no inducement to invest their capital in the erection of new buildings owing to the high cost of such work, which would result in unduly high rents which it would be difficult to collect.

13. To assist the construction of low cost working-class houses, special legislation has been passed, amongst which the following provisions may be noted :

— the possibility of obtaining loans on favourable terms either directly from the State or through duly authorised credit societies, or from the Railway Administration, when those requiring such loans are railway employees or staff co-operative societies;

— contribution paid by Governments or public institutions towards the cost of building or interest on capital invested; for example in Sweden by virtue of a special law rents are fixed on a pre-war basis (1939), whereas building costs have increased by 30 to 40 % and the State or Communes will grant special subsidies to make good this additional cost. Special facilities are granted in Belgium to those buying or building « low priced houses » for their own use;

— concession of special facilities for buying building land; free gift of sites on a 99 years groundlease; authorisation to purchase compulsarily, etc.;

— fiscal advantages consisting of the remission of all or part of the taxes and surtaxes on buildings for a given period, 10 years in some countries and 25 in others; granting of special reductions in stamp duties, mortgage charges, etc., in the case of deeds and contracts referring to low cost working-class houses.

In most countries, there are laws to prevent tenants against eviction except for serious reasons, as well as to prevent rents being increased above a certain given level. Such legislation does not as a rule apply to staff housed in railway houses, and the Administration is allowed to evict its own employees from the houses they are occupying whenever service requirements make it necessary.

Certain Administrations consider the provision of accommodation as part of their employees' salaries, and consequently when an employee is discharged, he must give up his house.

In certain countries, special legal measures relative to the use of accommodation provide that accommodation rendered available by the transfer of State employees to other Communes must be allocated to other State employees replacing those who have been moved. The same law, however, allows such accommodation to be reserved for certain grades of staff who must live in the « Commune » in the public interest (and consequently railway staff are also covered thereby).

14. The possibility of housing families, who must live within a limited budget in houses where they can have a proper standard of living, has always been a very important social problem from the national point of view.

This problem also has concerned Rail-

Railway Administration.	Total no. of employees.	Percentage of employees.		
		Living in railway property.	Living in their own property built with the aid of loans from the Railway or procured through the railway.	S to ho by Rail
1. *Austria.*				
State Railways	100 000	Unable to supply the details re		
2. *Belgium.*				
a) Belgian National Railways	73 234	5.20 %	60 %	0.5
b) National Light Railways	14 000	0.05 %	—	–
c) Brussels-Tervueren Electric Railway	100	10 %	—	–
3. *Bulgaria.*				
State Railways & Harbours	36 107	15 %	—	5
4. *Denmark.*				
a) State Railways			—	–
b) South Fünen Railway		Gave no details.		
5. *France.*				
a) Tunisian Railways	4 000	16 %		59
b) Congo-Ocean Railway	100	100 %	—	–
c) West African Railways	2 240	40 %	—	60
d) Togo Railways	33	73 %	—	27
e) Morocco Railways	2 400	33 %	7 %	8
f) Damas-Hama Railways and Extensions		Gave no details.		
6. *Italy.*				
State Railways	178 832	27 %	3 %	20
7. *Norway.*				
State Railways		Gave no details.		
8. *Holland.*				
Netherlands Railways	40 200	4 %	—	1
9. *Poland.*				
State Railways	261 000	Not in a position to supply		
10. *Portugal.*				
a) Portuguese Railways Company	21 500	19.5 %	—	27
b) Benguela Railway Company		Gave no details.		
11. *Rumania.*				
Rumanian Railways	150 000	1.5 %	1.2 %	20
12. *Sweden.*				
a) State Railways	59 500	Not in a position to supply		
b) Göteborg-Dalarne-Gävle Railway	4 189	19 %	—	–
c) Nora-Bergslagen Railway	210	37 %	—	–
d) Grängesberg-Oxelösund Railway	1 400	30 %	—	–
e) Stockholm-Roslagen Railway	710	19 %	—	–
f) Västergötland Railway	727	12.65 %	—	–
13. *Switzerland.*				
a) Swiss Federal Railways	32 000	8.7 %	8 %	–
b) Rhaetian Railway	1 261	33.3 %	—	–
14. *Czechoslovakia.*				
State Railways	190 000	13 %	—	33

(1) No details concerning utilisation of the remaining accommodation.
(2) Including gate houses occupied by private individuals.
(3) In calculating the number of rooms, the Administrations followed various practices. The Italian State Railw example include kitchens but not domestic offices; the Stockholm-Roslagen Ry. on the other hand does not count k others, who have made no special remarks in this connection, probably followed the practice given in the questi
(4) 198 dwellings were destroyed during the war.

	Houses owned by the Administration.				*Privately owned dwellings built by means of loans granted by the Railway or procured through the Railway.*		
o. f ings.	*No. of dwellings.*	*No. of rooms.* (3)	*Dwellings occupied by staff.*	*Dwellings occupied by retired employees, widows or private persons.*	*No. of buildings.*	*No. of dwellings.*	*No. of rooms.* (3)
g to destruction of administrative archives.							
	5 201		3 875	1 128 (4)		43 000	
	6		6	—	—	—	—
	10		10	—	—	—	—
	5 204		5 204	—	—	—	—
	3 000		2 500	500	—	—	—
00	891		650	(1)			
	100	2 574	100	—	—	—	—
	872		872	—	—	—	—
	24	3 344	24	—	—	—	—
	781		781	—		156	
	48 932	162 891	45 932	3 000 (2)	1 850	5 470	38 600
	1 535		1 500	35	—	—	—
etails asked for.							
	4 190		4 190	—	—	—	—
	2 200		Could not give exact figures.			1 927	
etails asked for.							
28	839	3 200	811	28	—	—	—
6	80	240	79	1	—	—	—
50	550	2 500	450	100	—	—	—
45	149	390	135	14	—	—	—
7	93	231	92	1	—	—	—
25	2 600	2 259	2 600	—	—	2 573	
	421		421	—	—	—	—
	25 105		25 105	—	—	—	—

way Administrations from the start as they employ a large number of employees, who frequently have to be moved from one place to another for service reasons, and sometimes have to live in places where there are no houses or very little available accommodation.

Accommodation for the staff, considered as an indispensable adjunct to a railway had naturally to be supplied in such cases; first of all houses were only built for employees who had to live permanently where they worked, alongside the permanent way, in stations and near railway installations.

Later on as the system and traffic developped, and also in order to meet the housing crisis which at times occurred in the most populous railway centres, houses were also built for other categories of staff. The war has had a certain effect on the development of building railway houses. Such building was stopped almost completely during the first world war, but started again with greater impetus at the end of hostilities.

The same thing happened with the second world war; stagnation during the years 1940 to 1944; at the present time much building activity in order to repair the damage done by the war and meet the future requirements of each Administration. This recovery is hindered however by the shortage of building material, the difficulty of transport, and in general by the after-effect of the war.

The table appended sums up the information supplied by the Administrations concerned on the subject of housing their staff. This table shows :

— the total number of employees;

— the percentage of : employees living in accommodation provided by the railway; employees living in their own homes built by loans given or guaranteed by the Administration; employees still to be accommodated by the Railway in order to assure the regular working of the railway;

— the number of dwellings and also as far as possible the number of buildings and rooms owned by the Administration, and similar information in the case of privately owned houses;

— the number of railway dwellings lived in by railway employees;

— the number of railway dwellings occupied by retired employees, the widows of deceased employees, or private individuals.

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

14th. SESSION (LUCERNE, 1947).

QUESTION IV.

The interest the Railway Administrations would have in building houses for the staff of all ranks, or in assisting the building of such houses,

(including policy and practice of Railway Administrations in connection therewith and advantages derived therefrom).

SUPPLEMENT TO REPORT (*)

(America, Great Britain, India, Dominions, Protectorates and Colonies, China and Egypt),

by A. P. J. BALL,

Estate Manager & Rating Agent, London Midland & Scottish Railway Company.

PART I.

Since my Report was completed replies to the Questionnaire have been received from the following :

Association of American Railroads.
Kenya and Uganda Railways and Harbours.
Egyptian State Railways.
The Madras & Southern Mahratta Railway (India).
Peiping-Hankow Railway (China).

QUESTION (1). — *What is the present policy and practice of the Railway Administrations in regard to the provision of housing accommodation for their staff or assisting in provision of such housing accommodation ?*

UNITED STATES. — Extensive provision is made for the housing of floating gangs or so-called extra gangs in camp cars and occasionally in portable camp buildings so that the men may be housed within a reasonable distance of where the work upon which they are engaged is in progress, the camps being moved as necessary.

Houses are provided for section foremen, telegraphers, signal maintainers and a few other classes of employees where it is necessary to employ persons permanently in sparsely settled territories where no form of housing is otherwise available.

KENYA AND UGANDA. — Housing is provided at the cost of the Administration and when not available, a monetary allowance in lieu is paid.

EGYPT. — Dwellings of standard types are constructed for platelayers at their posts along the railway. For other

(*) See *Bulletin of the International Railway Congress Association*, December 1946, p. 437/1.

staff, i.e. station-masters and their assistants, working in isolated places, lodgings are also provided.

INDIA. — Quarters provided for essential staff who are required to live near their place of work and are liable to be called for duty in an emergency, also for staff who have to attend to duty at inconvenient hours.

CHINA. — To provide a dwelling house for each staff member.

QUESTION (2). — (a) *Is there any existing scheme for providing houses for all classes of employees or for particular grades? Please give details.* (b) *Is it the practice to purchase or build houses for transferred staff who are without a house at their new place of work?* (c) *Is there any existing scheme for assisting in the construction of houses and flats for letting to railway employees, e.g., through building associations? Please give particulars.*

UNITED STATES. — No such schemes.

KENYA AND UGANDA. — Housing of an appropriate design is provided for the three classes of staff concerned, viz. European, Asian and African in Senior and Junior grades.

EGYPT. — (*a*) No scheme exists for all classes of employees. In general, houses are built for subordinate staff living in remote places.

(*b*) Houses are not purchased for transferred staff but are constructed in case of necessity.

(*c*) No, but the existing houses are let to the staff at low rents or rent free.

INDIA. — (*a*) It is proposed to provide for categories of staff mentioned in answer (1) during the post-war period 1947 to 1952.

(*b*) and (*c*) No.

CHINA. — There is an existing scheme for all classes of employees by construction of dwellings comprising two rooms together with kitchen and bathroom.

QUESTION (3). — *Give reasons or motives which have induced the Railway Administration to provide housing accommodation for their staff or assist in such provision.*

UNITED STATES. — In general housing is supplied only in circumstances where the employee would otherwise be without a place to live, that is, the permanent employees located at stations where there are no towns or the floating gangs of men without families. The current housing shortage in the United States has become a hardship to the employees of railways and other corporations alike but efforts on the parts of the railway managements to inject themselves into this picture would confuse rather than simplify the problem of meeting this temporary situation.

KENYA AND UGANDA. — Generally, housing is not available in East Africa to the same extent as in more settled countries, and it is usual for the Railway Administration to provide housing accommodation so that staff can be adequately and satisfactorily accommodated in close proximity to their place of work.

EGYPT. — Owing to non-existence of houses in vicinity and in order to keep staff near place of duty.

INDIA. — To ensure that essential staff live near place of duty and are available in an emergency. Also to provide houses where there is a scarcity or where it is impossible to obtain accommodation at reasonable rentals.

CHINA. — It is very convenient for the service.

QUESTION (4). — *Organisation and working of the Department responsible for the building, upkeep and management of staff housing accommodation, and for the working out and putting into effect of measures for encouraging such construction.*

UNITED STATES. — None.

KENYA AND UGANDA. — Building and maintenance done by Civil Engineering Department. At depot stations allocation is made by Housing Committees and at other places quarters are earmarked for specific posts.

EGYPT. — Plans prepared in Architect's office and construction carried out by Engineer.

INDIA. — Engineering department responsible for construction and maintenance. Accommodation allocated to various departments by whom quarters are allotted.

CHINA. — Under welfare department.

QUESTION (5). — *Please give a brief history of past house building by the Railway Administration and provide statistical information, columns* (a), (b) *&* (c) *below :*

UNITED STATES. — During the pioneer days of railroading, numerous railroad lines were built into unoccupied territory with the result that many of the stations were located at points where there were no towns, thereby imposing upon the managements the necessity of providing houses for their station employees, as well as for the track forces. However, as villages and cities were built up around the stations, the railroads gradually decreased their ownership of dwelling houses. The practice of providing houses for railway employees has declined from year to year.

KENYA AND UGANDA. — Quarters were originally built of wood and iron but these are gradually being replaced by more permanent types in stone or concrete blocks. Improved types are introduced from time to time as the need arises, especially in the case of Asians and Africans whose standard of living is steadily rising.

EGYPT. — No information.

INDIA. — No information.

	(a) Total number of staff of all ranks employed by Railway Administration.		(b) Proportion of staff who are householders or would be householders if sufficient housing accommodation was available.		(c) Total number of houses and flats owned by Railway Administration occupied by present employees.	
United States.	Information not available.					
Kenya and Uganda.	European	571	European	80 %	European	384
	Asian	2 731	Asian	90 %	Asian	1 707
	African	21 539	African	100 %	African	12 747
	Total	24 841			Total number of quarters	14 838
Egypt.	Information not available.					
India. Madras and Southern Mahratta Railway.	65 000		...		11 105	
China. Peiping - Hankow Railway.	19 447		1 : 20		1 373	

CHINA. — Blocks of dwellings in large centres and houses provided at other places according to service requirements.

QUESTION (6). — *Give information as to type of accommodation provided, e.g. groups of houses, whether terrace, semi-detached or detached; large or small blocks of flats; also particulars as to number of rooms — bedrooms, living rooms, kitchen, bathrooms, etc. and outside accommodation.*

UNITED STATES. — Since the houses owned by the railroads for the use of their employees are old, very few of them having been built in recent years, an answer to this question would not provide any data indicating current trends. Most of the houses are single or double of frame construction, although in a few cases the railroads have built terraces of small apartments for families of Mexican labourers.

KENYA AND UGANDA. — European houses are detached and situated in their own compounds. Senior accommodation : 3 or 4 bedrooms, dining room, sitting room, two bathrooms, two lavatories, stores, kitchen, garage and fuel store. Outquarters for four servants with kitchen, bathroom and latrine, varying down to two bedrooms and similar servants' quarters for junior staff. All houses have verandahs, some back and front. Asian quarters until recently were built in blocks of up to 8 quarters, but are now built semi-detached. Senior staff, 3 (a few with 4) living rooms, shower bath, store and kitchen, fuel store and room for one servant. Compounds with high wall. Junior staff have similar accommodation, but with two living rooms. All houses have one or two verandahs. Single Asians are allotted one room each and thus have to share quarters. African quarters of senior type are built in blocks of two, each having two rooms, kitchen, store, bathroom and front and back verandah. Latrines for joint use. Designs of buildings are being revised, and will include 3 roomed type. Junior type are smaller and have less facilities.

EGYPT. — Accommodation ranges from detached villas of 4 or 5 rooms, hall, lavatory, verandahs and terrace, down to one room, hall and lavatory (on railway premises) for lower grades.

INDIA. — Accommodation varies according to grade, a typical Officer's residence comprising 3 bedrooms, dressing and bathrooms, drawing room, dining room with service and storerooms attached, front and back verandahs on ground and first floor.

Lower grades have proportionately less rooms and facilities, but all types are now revised or under revision, and include provision of improved accommodation with W.Cs. and electric light, etc., where possible.

CHINA. — Detached and semi-detached; also large blocks. Bedroom 1, living room 1, kitchen 1, bathroom 1, and garden.

QUESTION (7). — *Give financial terms and conditions in connection with the provision of housing accommodation; average cost per unit (house or room, etc.) or on a cubic basis according to floor, locality, and for each type of building. Give rules adopted for fixing rents and comparison of these rents with those charged by private individuals.*

UNITED STATES. — Houses are rented to employees but there is no data available upon which to base any general trends or policies.

KENYA AND UGANDA. — Pre-war cost of European's houses was from £ 1 100 to £ 2 500, but present cost is

about 60 % higher. In the cases of Asians the pre-war cost was from £ 320 to £ 500, and for African grades, £ 65 to £ 180, and the 60 % increase also applies to these figures. No rents are charged as the provision of housing (or an allowance in lieu) is within the terms of appointment. The allowance in lieu is an amount not exceeding 15 per cent of the initial salary of the grade of the employee, subject to certain minimums according to grade and whether the employee is married. Generally speaking, it is cheaper for staff to reside in the housing provided, than to rent a house not railway owned.

EGYPT. — No information.

INDIA. — The cost of construction varies according to class of building and vicinity. Rents are on the basis of 4 per cent return on the pooled cost.

CHINA. — $ 150 silver dollars per 100 sq. ft. of one floor area. $ 250 silver dollars per 100 sq. ft. for two storey building. Rent is very low, e.g. about one dollar per house per month.

QUESTION (8). — *State financial repercussions of this housing construction and its management on the budget of the Railway Administration.*

UNITED STATES. — Too small to be of any consequence.

KENYA AND UGANDA. — Interest and amortisation 5 per cent of capital cost. Maintenance costs assessed at one per cent of capital cost. Renewals fund 1½ to 2½ per cent on replacement cost according to type of building.

EGYPT. — No information.

INDIA. — Annual allotment made in Capital Programme of the Railway Administration for the construction of quarters for staff. Expenditure incurred on maintenance of quarters is charged to working expenses. When staff, who are not eligible for free quarters, occupy railway quarters, rent is recovered from the occupants at 10 % of their salary or the assessed rent of the quarters, whichever is the less. In the case of lower paid staff, no adequate return is derived by way of rent on the capital expended. In general, the financial return on capital outlay is not sufficient to cover maintenance, interest and depreciation charges, and to this extent the provision of quarters represents a financial subsidy to the staff.

CHINA. — Annual financial provision.

QUESTION (9). — *Has the accommodation constructed up to now achieved the objects which the Railway Administration had in view ? Give particulars of any programme of new building, including characteristics of the types of houses proposed to be adopted, and rules to be followed for grouping of accommodation and utilisation of open space.*

UNITED STATES. — The railroads have no general programme upon which a comment could be made.

KENYA AND UGANDA. — Yes, objects in view have been achieved. 27 new European houses, 70 Asian and 600 African type are in hand or will be constructed shortly. Houses for senior officials are built on their own plots as available, but junior European quarters, while provided with individual gardens, are generally built in grouped units at a density of two per acre. Asian quarters are built in varying densities, according to grade, up to a maximum of 10 per acre. Facilities for recreation are provided in addition. African quarters are, generally, built in large locations to a density of about 30 units per acre, including space for shops, welfare clinics and children's playgrounds, but playing fields are extra.

EGYPT. — Yes.

INDIA. — Yes, to the extent to which houses have been provided.

CHINA. — No, object not yet achieved and programme in hand.

QUESTION (10). — *As regards existing staff housing accommodation :* (a) *Are staff allowed to remain in occupation after retiral ?* (b) *Are widows and families of deceased railwaymen-tenants allowed to remain in occupation ?* (c) *If answer to question* (a) *and* (b) *is « Yes », what is the method of providing houses for the successors to the retiring and deceased members of the staff ?*

UNITED STATES. — No established policy.

KENYA AND UGANDA. — No.

EGYPT. — No.

INDIA. — No.

CHINA. — No.

QUESTION (11). — *Give particulars of any scheme for modernising old railway-owned houses.*

UNITED STATES. — No scheme in effect.

KENYA AND UGANDA. — No general scheme in hand but improvements to old type quarters are made from time to time in order to bring them up to modern standards as far as this is possible.

EGYPT. — No information.

INDIA. — Details are being considered for improving old type quarters, but these have not yet been finalised.

CHINA. — By construction an additional floor to existing single storey dwellings.

QUESTION (12). — (a) *Would it be considered an advantage to the Railway Administration if they provided a house for every member of their staff ?* (b) *If so, what arguments are submitted in favour and what advantages would accrue to the Railway Administration ?*

UNITED STATES. — No knowledge that any railroad has considered such a proposal.

KENYA AND UGANDA. — No, except those whose duties necessitate close proximity to place of duty; greater efficiency is secured by having the staff residing in close proximity to their work.

EGYPT. — It might have been an advantage if lodgings were built before the war.

INDIA. — No, as some of the staff own their houses and prefer to live in them.

CHINA. — Yes.

QUESTION (13). — (a) *Do any schemes exist under which the Railway Administration assist their employees in purchasing houses for their own occupation ?*

(b) *If so, please give full particulars of financial arrangements (i.e., interest rates, percentage of loan, etc.), together with general and statistical information as to the extent members of the staff have taken advantage of such schemes.*

(c) *Could it be said that such schemes meet all reasonable requirements, and to what extent would they affect a general scheme for the provision of railway-owned houses for all members of the staff ?*

(d) *Could it be argued that the purchase by an employee of a house for his own occupation discourages him from accepting promotion involving his transfer to another place ?*

UNITED STATES. — In general railway employees, the character of whose service is such that they may anticipate transfer, prefer to live in rented houses. It is true that during the current housing shortage, employees and officers have occasionally declined promotion because it involved transfer to another place where there was scant hope of finding a place to live.

KENYA AND UGANDA. — No such schemes.

EGYPT. — No such schemes.

INDIA. — No such schemes.

CHINA. — No information.

QUESTION (14). — *Are there any Government and Municipal housing schemes, and do railway employees obtain any special allocation ?*

UNITED STATES. — Current government housing plans give preference only to persons released from service in the Army or Navy..

KENYA AND UGANDA. — Yes, Asian and African, but Railway staff do not obtain any special allocation, the Railway Administration making itself responsible for the housing of its own employees.

EGYPT. — No.

INDIA. — Railway servants can partake in certain Housebuilding Schemes run on co-operative basis in municipal or other areas.

CHINA. — No information.

QUESTION (15). — *What is the present position as to housing accommodation generally ? Is there a shortage ? Please give a description of the steps which are being taken to remedy any shortage. Is it appreciated that conditions vary considerably from one country to another, and an indication as to special difficulties would be helpful ?*

UNITED STATES. — There is a serious shortage of houses particularly in the larger communities but this extends also to villages and smaller cities in the vicinity of large industrial areas. Housing construction is being fostered by a special federal authority but shortage of materials have interfered seriously with progress in the programme.

KENYA AND UGANDA. — Acute shortage due to labour and materials for building being in short supply during the war; the position is gradually improving but progress is still hampered by slow delivery of necessary materials and fittings.

EGYPT. — Yes, owing to shortage of steel, wood, marble, etc., few new houses are being built.

INDIA. — The position in all urban areas is acute.

CHINA. — Yes, there is a shortage, which will take many years to remedy.

QUESTION (16). — *Is there any legislation or Government control affecting the construction or tenancy of houses ? Do tenants enjoy any general protection from eviction, and, if so, is the Railway Administration exempted in any way from such legislation by reason of the necessity for housing members of their staff ? A general reply on this aspect is desired. Does the Railway Administration enjoy any tax exemption ?*

UNITED STATES. — Tenants are protected against increases in rent and eviction through the agency of the Office of Price Administration. The railway managements receive no special treatment in the administration of the law as exercised by the O.P.A. The railroads do not enjoy any tax exemption.

KENYA AND UGANDA. — Building operations are controlled, permits being granted only in necessitous cases where materials are available or can be obtained. Tenants are protected by Rent Control Act and cannot be evicted unless they give cause to warrant such action. The Railway Administration has complete freedom in the allocation of railway-owned houses to their staff, but does not enjoy any exemption from the payment of Municipal rates and taxes where such exist.

EGYPT. — No.

INDIA. — There are Town Planning Acts which mainly affect the large cities. No protection against eviction exists

except as provided for in the Rent Control Order. The Railway Administration does not enjoy any taxe exemption.

CHINA. — No information.

* * *

PART II.

Summary.

The replies contained in part one may be briefly summarised as follows :

In the United States of America during pioneer days railways were constructed through unoccupied territory, thereby imposing upon the railway administrations the necessity of providing houses for staff. With subsequent development of towns and villages the railway ownership of houses gradually decreased and the practice of providing houses for staff has declined to the extent of becoming a negligible proposition.

The practice of the Kenya and Uganda Railways is to provide rent free housing accommodation for their staff as a part of the terms of employment or alternatively to make a monetary allowance in lieu thereof. Generally speaking, houses are not available in East Africa to the same extent as in more settled countries, and it is neccessary to provide accommodation so that staff can be adequately housed in close proximity to their work. The houses so far provided have fulfilled the objects in view but a further building programme is in hand. It is considered that greater efficiency is secured by such housing provision, but it would not be considered an advantage to provide a house for every member of the staff; only for those whose duties necessitate them living near to place of work.

The Egyptian State Railways provide housing for certain maintenance and operating staff, either at low rents or rent free, at places where accommodation is scarce or non-existent, and also for the purpose of having staff available whenever required. It would have been an advantage if more accommodation had been constructed before the war.

In India, the Madras and Southern Mahratta Railway provides housing accommodation for essential staff who are required to live near their place of work or who are liable to be called for emergency duty, and for staff who attend at inconvenient hours; also at places where there is a scarcity of private accommodation near the railway. Certain grades occupy rent free quarters under the terms of employment, and recovery of rent from the remainder is subject to a maximum of 10 per cent of pay. In the case of lower paid staff no adequate return is obtained on capital expended and, in general, the financial return is not sufficient to cover maintenance, interest and depreciation changes. It is considered that the objectives of the Administration have so far been achieved, and a further five year building programme has been embarked upon, although it would not be considered an advantage to provide houses for all staff as some prefer to live in their own houses.

The Peiping-Hankow Railway (China) aim at providing dwellings for all staff requiring accommodation as this is convenient for the railway service and a building programme is in hand with such object in view.

The further replies received do not materially alter the conclusions arrived at in my main report. It is again disclosed that there is considerable divergence in the established policy and practice in various countries regarding the provision of houses for staff by railway administrations, due, in a large degree, to the different conditions appertaining in each particular country. Support is given to the provision of railway owned houses in a varying degree but it would not be considered an advantage for this to apply to all members of the staff.

[625 .142]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

14th. SESSION (LUCERNE, 1947).

QUESTION I.

Sleepers :

a) different types;
b) maintenance methods;
c) financial comparison.

REPORT

(Belgium and Colony, Bulgaria, Denmark, Spain, Finland, France and Colonies, Greece, Hungary, Italy, Luxemburg, Norway, Netherlands and Colonies, Poland, Portugal and Colonies, Rumania, Sweden, Switzerland, Czechoslovakia, Turkey, Jugoslavia),

by O. LEDUC,

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CONTENTS.

PART I.

The different kinds of sleepers.

CHAPTER I.

General.

1. Different kinds of sleepers.
2. Sleepering. — Spacing of sleepers.
3. Track equipment. — Length and weight of rails.
4. Arrangement of sleepers at joints.
5. Section of the ballast.
6. General dimensions of sleepers. — Effect on the stability of the track.

CHAPTER II.

Wood sleepers.

1. The different kinds of wood used.
2. Dimensions.
3. Technical conditions of the specifications.
4. Source of supply of the sleepers.
5. Manufacture of sleepers.
6. Adzing and drilling.
7. Impregnation.
8. Attachment of rails to sleepers.
9. Kind of ballast used with wood sleepers.
10. Insulation of track laid on wood sleepers.
11. Causes of deterioration in sleepers.
12. Classification and re-use of sleepers.

CHAPTER III.

Metal sleepers.

1. Shapes and sizes.
2. Support and fastening of rails.
3. Kind of ballast used with metal sleepers.
4. Electric insulation.
5. Wear, repair, and reclassification.

CHAPTER IV.

Reinforced concrete transverse and longitudinal sleepers.

1. General.
2. The different types used on some European systems :
   a) Belgium.
   b) Italy.
   c) Poland.
   d) Switzerland.
   e) Czechoslovakia.
   f) Jugoslavia.
   g) France and Colonies.
3. The ballast used with reinforced concrete sleepers.
4. Electric insulation of track laid on reinforced concrete sleepers.
5. Research work carried out by the French National Railways in connection with reinforced concrete sleepers.
6. Track laid on longitudinal sleepers.

* * *

PART 2.

Maintenance methods.

CHAPTER I.

Maintenance of the level.

I. Methods used to maintain the level.

1. Shovel packing.
2. Tamping.
3. Rod ramming.
4. Limits for packing and tamping.
5. Maintenance of renewed track.
6. Influence of methods used to maintain the level on the sleepers.
7. Level of ballast.

II. Frequency of maintenance work.

CHAPTER II.

Maintenance of sleepers and fastenings.

I. Wood sleepers.

1. Repair of sleepers.
   A) Repairing the fastenings.
   B) Repairing the chairs and bearing and clamp plates.
   C) Repair of splits.
2. Replacement of sleepers.

II. Metal and reinforced concrete sleepers.

* * *

PART 3.

Financial comparison.

1. Comparison of the cost price of sleepers made of various kinds of wood.
2. Effects of the method used to fasten the rail.
3. Financial comparison of the methods used for maintaining the level.
4. Comparison of the relative cost of wood, metal or reinforced concrete sleepers.

* * *

SUMMARY AND CONCLUSION.

* * *

THE SLEEPER.

Foreword.

The only question on the agenda for the First Section (Way & Works) of the 14th Session of the Railway Congress Association deals with *Sleepers,* and the Permanent Commission decided that the investigation should be divided into the 3 following parts :

a) different types;
b) maintenance methods;
c) financial comparison.

The present report sums up the information and remarks received from railway administrations in all countries other than English speaking countries. A similar Report has been drawn up by Mr. TRAIN, Chief Engineer of the London & North Eastern Railway for the latter, and we got in touch with him in order to draw up a similar questionnaire, so that the information supplied by the different administrations and the results of our investigation should be comparable.

In our case 96 Railway Administrations in 27 different countries were consulted. The list is given in Appendix I. We received 54 answers, 39 of which gave positive information.

Many railways of secondary importance merely stated that they had no interesting information to give, either in view of their small size or on account

of the fact that present day difficulties made it impossible for them to collect the necessary data.

A certain amount of interesting information was received very late, so that it was impossible for us to deal with certain points as thoroughly as we should have liked to have done if the time had not been limited.

* * *

The sleeper is a very important constituant of the track, though the opinion is widely held amongst the uninitiated that the rail is the most important element.

The problem of the sleeper is therefore one of the most important questions at the present time for most railways; for some of them it is even a very great difficulty, as no easy solution seems within sight.

The demand is much greater than before the war; the destruction due to the war, requisitions by the military authorities and delay in carrying out track maintenance and renewal have all increased the need for new sleepers to a very considerable extent (1).

It takes a long time to make the wood sleepers which were used on a widespread scale in many countries; moreover war means a heavy consumption of timber; even the most richly wooded countries have had to draw very heavily on their resources.

The steel sleeper which since the development of siderurgy at the end of the last century has been widely used on some systems is a possible solution, which can rapidly fill the want, but this is out of the question in many countries owing to the crisis in the steel industry consequent upon the world coal shortage which seems unlikely to be solved in the near future.

The last hope is the concrete sleeper, trials of which have already been made over many years but so far these have not been altogether satisfactory, though their possibilities have not yet been exhausted.

These preliminary remarks show that the International Railway Congress Association had good reason to include the problem of the sleeper on the agenda of the 14th Session in view of existing conditions.

* * *

In order to be able to compare the statistics asked for, it seemed advisable to define four categories of track based on the importance of the traffic carried :

1. Lines where the maximum speed exceeds 95 km. (60 miles)/h. or run over by trains of at least 1 000 tonnes;

2. Lines where the maximum speed lies between 60 and 95 km. (37 and 60 miles)/h., or run over by trains of at least 500 t. but less than 1 000 t.;

3. Lines other than those included under 1 and 2;

4. Station sidings, i.e. sidings in stations which are not run over by interstation traffic or traffic from an important shed or shop to the station.

The questionnaire sent to the Administrations consulted consisted of three parts corresponding to the three subheadings of the question :

a) Different types of sleepers.
b) Maintenance methods.
c) Financial comparisons.

The first part is mainly descriptive.

Statistical details were first of all asked for in the case of each category of line concerning the different types of sleepers or other devices used to carry the track (stringers, continuous foundations, etc.), as well as the number of

(1) The French National Railways estimate that they need 25 000 000 sleepers to catch up with the accumulated shortage of 1940 to 1946. No doubt the needs of all the European countries are on the same scale.

sleepers per kilometre of line or per length of rail.

General statistics were then requested concerning the size of sleepers, effects of their length and width on their stability, etc.

Then special details concerning each type of sleeper :

— *Wood sleepers :* kind of wood, size and shape, production, preparation, impregnation, causes of deterioration, conditions of use, classification, effect of the ballast.

— *Metal sleepers :* size and shape, method of fastening, conditions of use, wear, alteration of classification, effect of the ballast.

— *Reinforced concrete sleepers :* ordinary or pre-stressed, size and shape, fabrication, reinforcement, method of fastening, conditions of use, causes of deterioration, influence of the ballast.

— *Stringers :* different types, methods of construction, methods of fastening the rail, arrangements adopted for draining the ballast on the inside of the track.

The second part dealing with *maintenance methods* was divided into three parts :

The first dealt with general methods used with all types of sleepers (maintaining the level, hand or mechanical tamping, approximate or measured shovel packing, results obtained).

The second part dealt more especially with *wood sleepers* (regulations concerning the replacement of sleepers, methods used to renew the holes, tighten up the fastenings, repair the rail support and mend split sleepers).

The third part covered *metal sleepers* and *reinforced concrete sleepers,* and in particular the maintenance of the fastenings and repairs to the sleepers.

The third part of the questionnaire had the subtitle : « Financial comparisons ». The Administrations were asked to give the first cost of each type of sleeper : wood, metal or reinforced concrete, for all conditions of utilisation, for example the cost of the actual sleeper without any fittings, and the cost of sleepers with fittings using either chairs or other methods.

In each case they were asked to give the cost price of a sleeper ready to be laid in the permanent way, the cost of laying it, and the total cost.

To make valid comparisons possible we thought it necessary to ask, in addition, for further details concerning the average life of a sleeper, the percentage that can be re-used and their average life when re-used; the cost of the different methods of impregnating for each kind of wood with an indication of the average quantity absorbed by each kind of wood, the cost of the products used, if any, to protect metal or reinforced concrete sleepers, the cost of the mechanical manufacture of sleepers, and finally the cost of the methods of maintenance by tamping or shovel packing.

In each case the pre-war cost was asked for, i.e. the 1939 figures, as well as the post-war cost, i.e. the 1946 figures, to eliminate disparities in price due to the war.

* * *

Part I.

DIFFERENT KINDS OF SLEEPERS.

CHAPTER I.

General remarks concerning sleepers.

1. *Different kinds of sleepers.*

Table I gives the lengths of each category of permanent way (1) laid with wood, metal or reinforced concrete sleepers.

(1) Appendix II shows the division of the lines of each system into four categories; Appendix III gives in addition the locomotive and wagon axle loads allowed on each category of line.

Tracks laid other than on sleepers were not included in this table as practically no such cases were reported by the Railways.

This Table shows that wooden sleepers are used on most of the railways; 90.2 % of the total lines concerned are laid on wood sleepers whereas only 9.4 % are laid on metal sleepers, and 0.4 % on reinforced concrete sleepers.

Many railways use wood sleepers exclusively, for example the railways in Denmark, Finland, the railways in France other than the French National Railways, Holland, the North Milan Railway, Norway, Portugal and the Swedish Railways.

Metal sleepers are only used on a large scale in Switzerland (on 68.2 % of the system); and Turkey (54.4 %), and on the following Colonial Railways :

Belgium :
Matadi-Leopoldville : 100 %
Lower Congo-Katanga : 99 %
Algeria : 35.4 %
Indo-China : 81.1 %
Damas-Hama : 100 %
Bagdad Syrian Railways : 100 %
Togo : 100 %
Tunisia : 34.3 %

It is true that on some of these Colonial Railways it is necessary to use metal sleepers in view of the destruction of wood sleepers by termites.

On the other railways, metal sleepers have only been used to any large extent as a result of the shortage of wood after the first world war :

Austria	6.4 %
Belgium	9.7 %
France	5.3 %
Italy	3.1 %
Luxemburg	9.3 %
Poland	2.7 %
Czechoslovakia	2.2 %
Jugoslavia	1.3 %

No law regarding the proportions of wood or metal sleepers on lines in the different categories can be drawn from the information received. Metal sleepers are used on lines of the 1st category as on the others. An examination of the table shows how the practice differs from one railway to another.

Concrete sleepers are only reported in small numbers, as only three Railways mention their use on more than 100 km. (62 miles) of lines :

France (French National Railways) : 690 km. (429 miles);
Algeria : 151 km. (94 miles);
Italy (State Railways) : 310 km. (192 miles),

and amongst these only the French National Railways report their use on an appreciable length of line coming under categories I and II (222 and 314 km. [138 and 195 miles] respectively), and these figures furthermore have been reduced after unsatisfactory trials made a few years before the war.

Five other Railways report small trial lengths laid with such sleepers :

Indo-China : 5 km. (3 miles).
Tunisia : 17 km. (10 miles).
Poland : 7 km. (4 miles).
Swiss Federal Rys : 4 km. (2½ miles).
Czechoslovakia : 4 km. (2½ miles).

This leads to the conclusion that the wood sleeper is much the most widely used; this preference is due to its undeniable qualities of flexibility, long life, good insulation, ease of fastening to the rail, ease and accuracy of maintenance, and low cost price.

The metal sleeper which was used on a fairly large scale towards the end of the last century does not seem to have made any further progress. It would seem therefore that the advantages it presents over the wood sleeper, especially as regards length of life if properly maintained, are not such as to make up for the drawbacks involved.

2. *Sleeper spacing — sleepering.*

Table II shows the sleepering, i.e. the number of sleepers per kilometre of track.

TA

Lengths of track laid

	Wood sleepers.				
	Category I.	*Category II.*	*Category III.*	*Category IV.*	*Tot*
Austria	1 140	3 510	2 350	2 860	9 8
Belgium :					
S.N.C.B.	3 346	2 616	786	5 174	11 9
Matadi-Léopoldville	...	...	...	...	...
Lower Congo-Katanga	...	...	13	...	
Denmark :					
State Railways	1 700	1 120	250	1 470	4 5
South Funen	...	103	115	61	2
Finland	645	3 973	194	1 700	6 5
France :					
S.N.C.F.	28 891	15 508	11 967	20 007	76 3
Somain-Anzin	76	53	...	347	4
Sté Gle Ch. de fer Economiques	...	327	3 007	350	3 6
Ch. de fer Economiques du Nord.	...	...	54	6	
Ch. de fer Vicinaux	...	...	131	7	
Paris Metro	...	42	373	61	
Algeria	...	...	...	...	2
Indochina	...	...	...	...	
Damas-Hama	...	...	...	...	
Bagdad Syrian Railway	...	...	...	...	
Togo	...	...	...	...	
Tunisian	749	192	44	...	1
Holland	1 900	2 100	650	1 750	6

metal or concrete sleepers
res).

	Metal sleepers.				Concrete sleepers.				
ry	Category II.	Category III.	Category IV.	Total.	Category I.	Category II.	Category III.	Category IV.	Total.
	300	240	140	680					
4	...	150	262	1 286					
	...	365	100	465					
	...	2 342	...	2 342					
4	1 664	706	383	4 537	222	314	87	67	690
	...	...	...	1 523	...	...	...	...	151
	...	...	...	1 935	...	...	...	...	5
	...	581	31	612					
	653	...	40	693					
	...	440	39	479					
)	0.4	...	...	679	17	...	...	...	17

TA

Lengths of track laid

	Wood sleepers.				
	Category I.	*Category II*	*Category III.*	*Category IV.*	*Tota*
Italy :					
Italian State Railways	...	...	...	...	28 5
North Milan	...	230	89	99	4
Luxemburg	76	200	454	180	9
Norway	...	3 900	390	930	5 2
Poland	...	...	...	...	39 2
Portugal :					
Portuguese Railways	645	1 944	...	486	3 0
North Portugal	...	...	178	18	1
Rumania	4 000	6 347	...	3 796	14 1
Sweden :					
Swedish State Railways	4 583	6 514	1 250	4 517	16 8
Stockholm-Roslagen	...	247	92	59	3
Norsholm-Västervick-Hultsfred . .	...	...	202	32	2
Nora-Bergslagen	...	...	173	48	2
Grängesberg-Oxelösund	257	46	...	202	5
Göteborg-Dalarne-Gävle	571	663	92	469	1 7
Västergötland-Göteborg	...	240	...	50	2
Switzerland :					
Swiss Federal Railways	1 057	160	...	729	1 9
Rhaetian Railways	...	...	...	...	
Czechoslovakia	3 456	4 358	4 395	...	12 2
Turkey	...	...	...	...	3 2
Jugoslavia	1 650	4 052	4 252	2 643	12 5

tinued.)

etal or concrete sleepers

es).

	Metal sleepers.				*Concrete sleepers.*				
ry	*Category II.*	*Category III.*	*Category IV.*	*Total.*	*Category I.*	*Category II.*	*Category III.*	*Category IV.*	*Total.*
	...	...	...	886	...	...	...	...	310
	7	48	38	93					
	...	...	...	1 093					
	811	...	1 279	4 001	3	...	...	1	4
				290					
	...	...	...	714	...	...	4	...	4
	...	...	...	3 933					
	17	...	...	17					

TABLE II.

Sleepering — length — weight of rails per m. — number of sleepers per rail. Distance between centres of sleepers at joints — Ballast (recent renewals)

	Sleepering (No. of sleepers per km.).	*Latest type of rails.*			*Distance between centres of sleepers at joints. (mm.)*	*Ballast.*			*Remarks.*
		Lenght. m.	*Weight per m.*	*No. of sleepers per rail.*		*Bed. (cm.)*		*Thickness. (cm.)*	
						Straight.	*Curves.*		
Austria	1 566	30	49	47	260	100	100	29	
	1 600	15	49	24	260	100	100	29	
Belgium :									
S.N.C.B.	1 666	27	50	45		...	...	...	V $\geqslant$ 120
	1 593	...	...	43	264	...	...	...	120 $>$ V $\geqslant$ 90
	1 518	...	...	41	or	...	...	...	90 $>$ V $\geqslant$ 70
	1 722	18	50	31	354				
	1 610	...	...	29		85	100 (1)	30	(1) R $<$ 600 m.
	1 500	...	...	27		...	...	34.5 (2)	(2) On curves of small radius.
Matadi-Léopoldville	1 500	12	33.4	18	506				
Lower Congo-Katanga	1 500	12	37.5	18					
Denmark :	1 676	60	60	99	Oak: 310	93	93	30	
	1 666	30	60	50	Deal: 260				
South Funen	1 390	18	37	25	720				
Finland	1 500	20	43.567	30	270	94	94	50	
France :									
S.N.C.F.	1 722	18	50	31	280	90	90	35	
Somain-Anzin	1 500	18	46	27	280	100	100	20	
Sté Gle Ch. de fer Econom.	1 300	18	30	23	400	90	90		
Ch. de fer Econom. du Nord	1 175	8	34	10	240	100	100		
Ch. de fer Vicinaux	1 066	15	26	16	400				
Paris Metropolitan	1 722	18	46	31	280	...	...	...	Suburban system.
	1 277	18	52	23	Supported joint-o	...	...	...	Urban system.
Algeria	1 500	36	49.540	L	280	100	100	30 to 50	
	1 500	24			280				

Holland	1 666	24	46	40	580 or twin. (245)	120	120	25	Category I.
	1 333	24	46	32	»	120	120	25	» II.
	1 333	15	38	20	»	120	120	25	» III and IV.
Italy :									
Italian State Railways	1 333 to 1 666	36	49	50, 52, 56, 60	540 or 240	93	93	35 to 44	
	1 333 to 1 666	18	49	25, 26, 30	...	93	93	—d°—	
North Milan	1 444	36	46.3	52	540				
Luxemburg	1 680	24	46	40	270	...	...	30	
	1 533	30	49	46	254	...	...	30	
Norway	1 200	15	49	18	250	97	107	50	
	1 584	12	35	19	170	97	107	50	
Poland	1 611	18	49.05	29	270	85	85	25	
	1 566	30	—d°—	47	270	85	85	25	
Portugal :									
Portuguese Railways	1 666	18	45	30	490	100	100	25	Category I.
						85	85	20	» II.
North Portugal	1 250	12	25	15	500	75	75	15	V.E.
Rumania	1 566	30	49	47	270	85	95	20	
Sweden :									
Swedish State Railways	1 640	20	50	32	twin				
Stockholm-Roslagen	1 400	30	34.5	45	450				
Norsholm-Västervick-Hultsfred	1 500	15	24.8	22	500				
Nora-Bergslagen	1 250	20	43	25	420				
Grängesberg-Oxelösund	1 325	40	43	53	425	...	...	44	
Göteborg-Dalarne-Gävle	1 500	20	45.8	30	twin or 530	...	...	35	
Västergötland-Göteborg	1 333	15	24.8	20	412				
Switzerland :									
Swiss Federal Railways	1 556	36	46	56	wood 250 steel 216	90	90	25	
Rhaetian Railways	1 468	15	30.1	22	wood 240 steel 156	70	70	15	V.E.
Czechoslovakia	1 680	25	49.71	42	250 or	100	100	wood 30 steel 25	A.
	1 500	20	44.35	30	450	100	100		
Turkey	1 399	15	46	21	390	...	...	40	
Jugoslavia	1 500	20	45.25	30	twin	90	90	29	Category I.
						85	85	25	» II.
						65	65	16-18	» III.

The figures vary according to the kind of rails, so we have shown in the same table the principal types of rails used in the most recent renewals : length and weight, and the number of sleepers per length of rail.

There is considerable variation in the spacing : 1 250 sleepers per km. (Hama-Bagdad-Syria) to 1 722 (Belgium, French National Rys, Paris Metro) for standard gauge lines, and 1 066 (Light Railways) to 1 500 for narrow gauge lines.

The spacing usually depends on the traffic the line carries, the sleepers being nearest together on lines with the heaviest loads or faster speeds.

In Holland for example there are 1 333 sleepers per km. on lines in categories II, III and IV, but 1 666 sleepers per km. in lines of category I.

In Belgium (Belgian National Railways) the spacing depends on the speeds : 1 722 if it exceeds 120 km. (74 miles)/h., 1 610 if the speed lies between 90 and 120 km. (56 and 74 miles)/h., and 1 500 if it is less than 70 km. (43 miles)/h.

In France in the case of the standard 18 m. (60') rail, there are two sleeper spacings, 1 722 sleepers per km. being used in the case of lines in category I and 1 610 in the case of lines in categories II and III.

On other railways the sleeper spacing depends not only on the traffic and speeds, but also on the profile of the line; in Czechoslovakia for example and Italy and Jugoslavia, the radius of curves and gradients are taken into account. In Czechoslovakia, in the case of the so-called Class A permanent way the following rules are followed : 1 250 sleepers per km. Categories I, II and III, 1 400 sleepers of $R \geqslant 400$ and $p' \leqslant 10$ %, 1 500 sleepers if $R < 400$ or $p > 10$ %.

As a general rule, it may be stated that modern lines in Category I are laid with more than 1 500 sleepers per kilometre and there is a tendency to increase the number to meet the increased loads and speeds (Switzerland : sleepering increased from 1 388 to 1 610 sleepers per km.).

Closer spacing, however, is limited on the one hand by reasons of economy, and on the other by maintenance difficulties; there must be a sufficiently large space between the sleepers for using the tools needed for tamping or shovel packing.

Lines in Category II are laid with fewer sleepers (Norway : 1 200, Sweden : 1 250 to 1 400); in the case of Category III lines there may only be 1 066 sleepers per km. (French Light Railways) on narrow gauge lines.

The railways do not report that the type of sleeper used influences the spacing adopted, and those using both wood and metal sleepers, space both types at approximately the same intervals (Italy, Switzerland), though the spacing of metal sleepers is a little wider than the spacing adopted with wood sleepers on other systems (Italy : 1 666; Switzerland : 1 556). The French National Railways were the only railway to give details on the sleepering adopted in the case of concrete sleepers : 1 500 sleepers per km. in the case of the oldest Callot sleepers and 1 272 to 1 474 in the case of the newest Orion sleepers. The spacing for the recently designed pre-stressed reinforced concrete sleepers has not yet been decided, but the French National Railways intend to space these at the same intervals as wood sleepers, at least to begin with.

3. *Track equipment, length and weight of rails.*

At our request the railways advised us the lengths and weights of the rails used in recent permanent way renewals. We thought it interesting to investigate as well as the average number of sleepers per km., as above, and the number of sleepers per length of rail, in terms of their weight. Increasing the weight

of the rail should make it possible to use less sleepers for the same length.

As regards length of rail, 18 m. rails have been used on most railways in the case of recent renewals. To reduce the number of joints to the minimum, as these are always the weak point of the track, the railways have endeavoured to increase the length of rails used, but possibilities in this direction are limited by difficulties of manufacture and handling, and above all the question of expansion, as reducing the number of joints means that larger gaps have to be left. This however is another problem that requires thorough investigation.

On the French National Railways, the length of rails used was increased from 8 to 12 m. (26′3″ to 39′4½″) then to 18 m. (60′) and finally to 24 m. (78′9″) after which the length was once more reduced to 18 m., as the gaps required in the case of 24 m. rails to meet normal expansion were too large to keep them in good repair. Other railways sometimes use rails longer than 18 m.. : 30 m. (98′5$^{1}/_{8}$″) in Austria, Denmark, Luxemburg, Poland and Sweden, and 27 m. (88′7″) in Belgium, but in this case these railways use K type fastenings with which we shall deal later on, which makes possible fairly high stresses in the rails and consequently a reduction of the gap. Other railways use welded rails of still greater lengths : 36 m. (118′) in Italy, France (as a trial), Switzerland and Algeria : 40 m. (131′) in Sweden : 60 m. (197′) in Denmark. It may be mentioned here that long welded rails are used on underground railways where the temperature remains practically constant.

As regards the section and weight of rails, only France and Austria to a small extent have reported the use of double headed rails. As France has given up using this section, which was formerly used on the Paris-Orleans and Midi Railways, it may be said that Vignoles rails are practically the only type used in Continental Europe.

The constant increase in axle loads and speeds has led the railways to use heavier and heavier rails, and on lines in Category I, the rails used always weigh at least 45 kgr./m. (100 lbs.); 49 kgr. (108 lbs.) in Austria, Italy, Luxemburg, Norway, Poland and Czechoslovakia, 50 kgr. (110 lbs.) in Belgium and France, 52 kgr. (114 lbs.) on the Paris Metropolitan, and 60 kgr. (132 lbs.) in Denmark. In France there are also 62 kgr. (136 lbs.) rails on a few hundred kilometres of line, as this weight was adopted by the P. L. M. before the creation of the French National Railways.

Rails of lower weight on lines of this category are gradually being taken out of service when the track is renewed for re-use on lines in Categories II, III and IV where at the present time there are rails of all types from 24.8 kgr. (54.674 lbs.) (Sweden) up to 46 kgr. (101.413 lbs.)

From an examination of Table II it does not appear that the weight of the rail has any real effect on the number of sleepers used. From the information collected, it does not seem that the railways using heavier rails have profited therefrom to reduce the number of sleepers per rail. For a given railway, this number, as we have already said, is a function of the traffic; the same remarks apply as those made previously in the case of sleeper spacing.

Amongst the most widely used arrangements, the following ways of laying rails may be mentioned :

a) 49 kgr. — 36 m. (118′) on 50, 52, 56, 60 sleepers (Italy);

b) 49 kgr. — 30 m. (98′) on 47 sleepers (Austria) and 46 sleepers (Luxemburg);

c) 50 kgr. — 27 m. (89′) on 41, 43, 45 sleepers (Belgium);

d) 46 kgr. — 24 m. (79′) on 40 sleepers (Luxemburg);

e) 50 kgr. — 18 m. (60′) on 27, 29, 31 sleepers (Belgium) or 29, 31 sleepers (France);

f) 46 kgr. — 18 m. or 29, 31 sleepers (France).

It may be mentioned that in Algeria the number N of sleepers per length L of rail is given by the formula :

$$N = L + \frac{L}{2} \text{ i.e. for 24 m., 36 sleepers.}$$

The profile of the line does not usually affect the way the rails are laid, though on certain railways it is reinforced on curves.

For example in Holland and the French Chemins de fer Economiques du Nord, the track is strengthened when the radius is less than 750 m. (2 460′) or 400 m. (1 312′) respectively.

In Tunisia, when the radius is less than 500 m. (1 640′), 3 sleepers are added per length of 18 m.

On the North Milan Railway 60 sleepers instead of 52 are used with 36 m. rails when the radius is less than 600 m. (1 968′).

On the North Portugal Railways, with 12 m. (40′) rails, 15 sleepers are used on straight sections and curves of more than 500 m. radius, 16 sleepers on curves between 250 and 500 m. (820′ and 1 640′) and 17 on curves of less than 250 m. radius.

Other railways also take the profile of the line in account : Czechoslovakia, Jugoslavia and Italy for example as already reported. In Jugoslavia for example 30 sleepers are used instead of 29 in the case of 20 m. (66′) rails when the radius is less than 300 m. (984′) or the gradient more than 10 ‰.

Finally, the Swiss Railways prefer to use metal sleepers rather than wood ones on curves.

4. *Arrangement of sleepers at joints.*

In most cases the railways use opposed joints; the Paris Metro is the only one to report the use of staggered joints. The joint rests on one wide sleeper (.30 m. [11$^{13}/_{16}$″] instead of .24 m. [9$^{7}/_{16}$″]) and the joints in one line of rails are staggered .73 m. (2′4$^{3}/_{4}$″) with respect to the others.

Most railways use the same sleepers at joints as along the rails. However the best squared off and strongest sleepers are usually selected for this position. The North Milan Railway reports the use of 260 × 13 × 25 sleepers at joints instead of the usual 251 × 13 × 22, i.e. longer and wider sleepers.

The distance between centres of sleepers on each side of a joint varies a lot, and is generally shorter than the pitch of those laid under solid rail. The present tendency seems to be to put the sleepers closer together, or even touching each other : two ordinary wood sleepers bolted together (French Chemins de fer Economiques du Nord, Italy, Holland, Sweden, Czechoslovakia, Jugoslavia, Norway);

— special double metal sleepers (Switzerland);

— ordinary wood or metal sleepers laid very close together (Austria, Belgium, French National Railways, Somain-Anzin, Paris Metro (suburban system), Algeria, Luxemburg, Poland) in which case the distance between centres variès from 260 to 284 mm. (10$^{1}/_{4}$ to 11$^{6}/_{32}$″).

On other railways the sleepers at joints are laid some distance apart, 310 mm. (1′$^{3}/_{16}$″) (Denmark), 354 mm. (1′1$^{29}/_{32}$″) (Belgium), 400 mm. 1′3$^{3}/_{4}$″) (Société Générale des Chemins de fer Economiques, Chemins de fer Vicinaux), 480 mm. (1′6$^{7}/_{8}$″) (Indo-China), 540 mm. (1′9$^{5}/_{16}$″) (Italy), 580 mm. (1′10$^{13}/_{16}$″) (Holland), and even 720 mm. (2′4$^{3}/_{8}$″) (South Funen Railways).

It should be mentioned that certain railways, for example those of Belgium, Holland, Italy and Czechoslovakia are using both supported and overhung joints at the present time. One railway reports the use of joints supported on a single sleeper (Paris Metro — urban lines), which is another case of staggered joints, reported above.

The kind of wood used does not seem to affect the question. Denmark is alone in reporting that deal sleepers are spaced at 260 mm., whereas oak sleepers are 310 mm. apart.

5. *The ballast.*

The width, counted from the centre of the rail, varies between 85 cm. (2′9½″) (Belgium) and 135 cm. (4′5$^{1}/_{8}$″) (Tunisia) in the case of Category I lines; in most countries it is of the order of 90 to 100 cm. (2′11½″ to 3′3$^{3}/_{8}$″) the width being increased at curves only in Belgium and Norway. In Belgium it is increased from 85 to 100 cm. (2′9½″ to 3′3$^{3}/_{8}$″) when the radius is less than 600 m. (1 968′), and in Norway from 97 to 107 cm. (3′2¼″ to 3′6$^{1}/_{8}$″).

The depth of ballast under the sleeper in line with the rail varies from 25 cm. (9$^{27}/_{32}$″) (Poland, Switzerland, Holland), and even 20 cm. (7$^{7}/_{8}$″) (Portugal) to 50 cm. (1′7$^{11}/_{16}$″) (Norway, Finland, Algeria), the most usual depth being of the order of 35 cm. (1′1$^{3}/_{4}$″) (French National Railways). On curves this dimension is maintained beneath the lower rail, while in Belgium it is even increased to 34.5 cm. (1′1$^{37}/_{64}$″) instead of 30 cm. (11$^{13}/_{16}$″). In the case of metal sleepers, the depth is sometimes less; Czechoslovakia reports 25 cm. (9$^{27}/_{32}$″) instead of 30 when wood sleepers are used, and it is also 25 cm. in Switzerland where most of the sleepers are metal.

The regulations for lines in other categories were not asked for; the Portuguese Railways however report that on Category II lines the width of the bed is reduced from 100 to 80 cm. (2′7$^{1}/_{2}$″), though the depth remains 20 cm. (7$^{7}/_{8}$″). Likewise the Jugoslavian Railways use beds of 90, 85 and 65 cm. (2′11$^{1}/_{2}$″, 2′9$^{1}/_{2}$″ and 2′1$^{5}/_{8}$″) for lines in Categories I, II and III respectively, the depth being 29, 25 and 16 to 18 cm. (11$^{7}/_{15}$″, 9$^{27}/_{32}$″, and 6$^{9}/_{16}$″ to 7$^{3}/_{32}$″).

The effects of the ballast will be dealt with later on when dealing with wood, metal or concrete sleepers. However it may be stated that all kinds of ballast have been used from sand or clinker to 50/60 crushed stone. On the Category I lines of the French National Railways at the present time 20/50 crushed stone or slag 20/55 ballast is used with wood, metal or concrete sleepers, as experience has proved these to give the best results.

6. *Leading dimensions of sleepers. — Effect of the length and width of sleepers on the longitudinal and transversal stability of the track and on the formation of splits in the wood.*

As far as length is concerned, it appears advisable that the sleeper be neither too long nor too short; in the first case it will have a tendency to curve downwards so that only the middle rests on the ballast and it will rock. In the latter case, it will have a tendency to curve upwards, with the result that the two ends are driven into the ballast owing to the bearing surface being insufficient.

The Swiss Railways whose sleepers used to be 2.70 m. (8′10$^{1}/_{4}$″) long, have reduced them to 2.50 m. (8′2$^{7}/_{16}$″); the Jugoslavian Railways now use 2.60 m. (8′6$^{3}/_{8}$″) long sleepers instead of 2.70 m., while the Paris Metropolitan which formerly used 2.20 m. (7′2$^{5}/_{8}$″) long sleepers has now increased the length to 2.30 m. (7′6$^{9}/_{16}$″).

The usual lengths of 2.50 to 2.60 m.

would therefore appear to be fully justified by experience.

On the other hand, Austria has pointed out that long sleepers give greater stability on curves than short ones; Finland uses longer sleepers on embankments; in marshy districts in Italy, it has been found that the stability of the track is greatly increased by the use of one or two longer sleepers at intervals.

Reinforced concrete sleepers are usually shorter than wood sleepers; there is no fear of them curving, whereas longer sleepers might be excessively stressed; on the other hand, the stability of the track is greatly increased by the actual weight of such sleepers, without it being necessary to increase their length to obtain this effect.

It does not appear that the length of wood sleepers has any effect on the formation of splits; only Finland and the South Funen Railways report this to any extent, and the Somain-Anzin Railways draw attention to the fact that it is necessary to keep the chairs away from the ends of the sleeper where splits generaly start.

As regards the width of sleepers, Austria reports that narrow sleepers offer less resistance to transversal and longitudinal movement of the track. The Somain-Anzin Railways report the use of sleepers 24 to 25 cm. ($9^{7}/_{16}$" to $9^{27}/_{32}$") wide on lines in Categories I and II, and 20 to 24 cm. ($7^{7}/_{8}$" to $9^{7}/_{16}$") on lines in Categories III and IV, as wider sleepers give better protection against the track creeping under the effects of hunting, and also give better distribution of the load on the ballast. The Swiss Railways finally report that they have obtained better stability of the track by increasing the number of sleepers without changing the width, and by decreasing the length.

It is evident that in order to distribute the load over the ballast, to increase the frictional resistance of the ballast to longitudinal and transverse displacement (due to creep and nosing respectively) as large a bearing surface as possible must be provided. The length, however, is limited in practice to an average dimension as we have seen, and the width by considerations of economic supply, and the sleeper spacing by maintenance requirements.

It would seem therefore that the closest modern spacings, the result of a compromise, represent the maximum bedding of the track for the types of rail now used.

An increase in the bed might be sought by using longitudinal supports such as stringers or paving stones, but as already stated none of the railways consulted report any great experience of such methods.

CHAPTER II.

Wood sleepers.

1. *Different kinds of wood used.*

Table III shows in the case of each railway using wood sleepers the percentage of sleepers in the different kinds of wood used before the war.

Apart from the Scandinavian countries and Austria, which are rich in conifers but short of hard woods, the latter are used almost exclusively, especially oak and beech, soft woods being used for lines with little traffic, especially sidings (Category IV).

On the main lines the only use of soft wood reported is that of track laid with bull-headed rails on large chairs on bearing plates. The French National Railways report for example such a case on the old Midi lines, a great part of the main lines of this system being laid on sleepers made of pine from the Landes. The bull-headed rail is also used in Austria, but laid on hard wood sleepers.

As a general rule the railways obvi-

TABLE III.

Percentage of woods used.

Railway.	*Oak.* %	*Beech.* %	*Conifers.* %	*Various.* %
Austria	10	10	80	
Belgium	85	15	0	
Denmark :				
State	0	40	60	
South Funen	0	0	100	
Finland	0	0	100	
France :				
S.N.C.F.	65	25	10	
Somain-Anzin	100	0	0	
Société Générale des Chemins de fer Economiques	100	0	0	
Chemins de fer Economiques du Nord	100	0	0	
Chemins de fer Vicinaux	100	0	0	
Métro de Paris	100	0	0	
Algeria	100	0	0	
Indochina	0	0	0	100
Tunisia	100	0	0	
Holland	30	10	60	
Italy :				
F.S.	58	37	5	
North Milan	100	0	0	
Luxemburg	15	85	0	
Norway	0	0	100	
Poland	14	0	85	1
Sweden :				
State	0	0	100	
Norsholm-Västervik-Hultsfred	5	0	95	
Other railways	0	0	100	
Switzerland :				
Federal Railways	54	40	6	
Rhaetian Railways	98	0	2	
Jugoslavia	68	30	2	

ously try to make the maximum use of the resources of the country. For example :

— the Scandinavian countries use pitch-pine and Scotch fir;

— Austria use larch, epicea and Scotch fir;

— France in addition to oak and beech uses pine from the Landes; and to a small extent acacia, hornbeam, elm, Scotch fir and larch;

— Algeria uses a special native variety of oak;

— Italy uses russian or turkey oak, and also eucalyptus and elm;

— Indochina uses local woods such as nghien, sao, son and dang-huong;

— the Lower Congo-Katanga, tropical woods such as mukulungo, kamashi and mubafu.

Mention may also be made of the use to a limited degree in France, Algeria and Tunisia of the native woods of Equatorial Africa.

The effects of the last war have been seen in most countries in a shortage of the kind of wood generally used, which had led the railways to draw upon other sources to make the deficit good, this being often considerable and increased still further by the destruction of the permanent way.

These other sources have usually been soft woods, grown in the country but not used or little used formerly, or else imported timber.

The same policy may have to be followed for many years to come to enable the railways to get a sufficient stock of sleepers to meet the demand due to wartime destruction and arrears in maintenance.

Table IV gives certain characteristic information in this connection.

The Swiss Railways, who only used hard wood before the war, report the use during the war of larch and deal on lines in categories other than Category I, on straight sections and curves of more than 450 m. (1 476′) radius. They propose to use nothing but hard woods now the war is over and will meet any deficiency that cannot be met by importing oak from France in particular by the importation of colonial woods.

2. *Dimensions and shapes of wood sleepers.*

STANDARD GAUGE.

The sleepers are generally 2.60 m. (8′6$^{3}/_{8}$″) long. The length varies however from railway to railway, according to the category of the line, from 2.30 to 2.70 m. (7′6$^{3}/_{16}$″ to 8′10$^{1}/_{4}$″).

The average thickness of the sleepers is 0.15 m. (5$^{29}/_{32}$″) with a maximum of 0.17 m. (6$^{21}/_{16}$″) and a minimum of 0.11 m. (4$^{11}/_{32}$″).

The average width is 0.25 m. (9$^{27}/_{32}$″), the maximum 0.30 m. (11$^{13}/_{16}$″) and the minimum 0.20 m. (7$^{7}/_{8}$″).

The different shapes and dimensions of sleepers have led the railways to classify them into several series or classes, each of which can be used on a given category of line.

The number of series or classes varies :

— Often 2: Belgium, Denmark (State) and Austria, South Funen, Somain-Anzin Railway (France), Holland, Sweden (State and other Railways), Switzerland (Swiss Federal Railways);

— 3 in the case of Finland;

— 4 in the case of the French National Railways, Morocco Railways, Algeria, Tunisia, Italy (F. S.), Luxemburg and Jugoslavia;

— In Poland there are 6 classes;

— The small railways often only have one class.

Sleepers in the first series are usually

TABLE IV.

Variation in the proportion of the different woods used.

A : Before the last war. B : During. C : After the war.

Railways.		*Oak.*	*Beech.*	*Conifers.*	*Various.*
Belgium	A	85	15	0	
	B	60	40	0	
	C	15	5	80	
France :					
S.N.C.F. (1)	A	65	25	10	
	B	72	14	14	
	C	74	18	8	
Somain-Anzin	A	100	0	0	
	B	80	20	0	
	C	80	20	0	
Algeria (2)	A	100	0	0	
	B	74	0	1	25
	C	78	4	8	10
Tunisia (3)	A	100	0	0	
	B	92	0	0	8
	C	65	0	8	27
Italy :					
Italian State Railways (4)	A	58	37	5	
	B	58	38	4	
	C	65	34	1	
Luxemburg	A	15	85	0	
	B	0	80	20	
	C	70	30	0	
Czechoslovakia	A	19	42	39	
	B	6	27	67	
	C	7	24	69	

(1) In France (S. N. C. F.), however, there is an increase in the percentage of oak sleepers and a reduction in that of beech sleepers, whereas on most railways the opposite is the case. In fact the number of oak sleepers used has decreased, but the reduction in the number of beech sleepers has been even greater. This policy has been due to the shortage of creosote; the railways did not wish to use beech sleepers, which are particularly susceptible to rot, on the permanent way until they had been impregnated, and owing to the large amount of creosote necessary for this purpose, it was only possible to treat and use a small number of beech sleepers. Oak sleepers, which require only about one third as much creosote, were used to a greater extent proportionally, especially as being much less susceptible to rot, they were often used without being impregnated.

(2) In Algeria the sleepers used before the war were 70 % of oak from France and 30 % of the native oak of the country.

These proportions have become :

— During the war 12 % and 62 % ;

— Since the war 18 % and 60 %.

In addition use has been made of wood imported from the Congo and Camerouns (15 %) and Gibeon (10 %).

(3) In Tunisia before the war 95 % of native oak and 5 % of French oak was used. During and since the war no oak was imported from France, and the use of native oak was 92 % during the war and has amounted to 65 % after the war. The deficit during the war was met by using eucalyptus (8 %) and after the war, pine (8 %) and azobe from the Camerouns (27 %).

(4) In Italy, the percentage of russian oak fell from 35 % to 25 % and then 23 %, while that of turkey oak increased from 23 % to 33 % and then 42 % , at the same time as a few elm and eucalyptus sleepers made their appearance.

of a standard length of 2.60 m. However the length is 2.50 m. (8′2⁷/₁₆″) on the South Funen Railways, while Holland requires it to be 2.65 m. (8′8³/₈″) and Finland and Sweden 2.70 m.

The width varies from 0.28 m. (11¹/₃₂″) (Belgium) (¹) to 0.24 m. (9⁷/₁₆″) (South Funen).

The most usual width is 0.25 m. (9²⁷/₃₂″).

The thickness varies from 0.16 m. (6⁵/₁₆″) (Austria, Denmark, Finland, Poland, Jugoslavia) to 0.14 m. (5¹/₂″) (Belgium, South Funen, Norway).

The length of sleepers in the lower series does not vary much, except in South Funen (2.40 m. [7′10¹/₂″] instead of 2.50 m.), in Austria (2.50 m. instead of 2.60 m.), in Holland (2.55 m. [8′4⁷/₁₆″] instead of 2.65 m.) in Italy (2.45 m. [8′3⁷/₁₆] instead of 2.30 m. [7′6⁹/₁₆″] or 2.60 m.) in Sweden (2.50 m. instead of 2.70 m.), in Jugoslavia (2.30 m. instead of 2.60 m.).

On the other hand the width varies in every case. It is 0.25 m. (9²⁷/₃₂″) in Denmark for the 2nd class,

0.24 m. in Austria, Belgium,

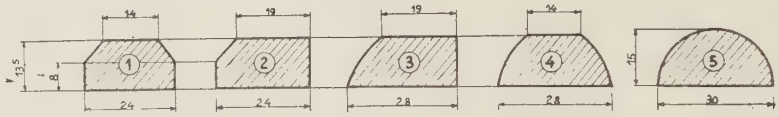
0.23 m. (9¹/₁₆″) in Norway,

0.22 m. (8¹¹/₁₆″) in Italy,

0.21 m. (8¹/₄″) in Sweden,

0.20 m. (7⁷/₈″) in France (S. N. C. F.), Jugoslavia.

As an example here are some shapes and dimensions generally adopted :



It should be pointed out however that only shapes 1 and 3 are now allowed on the French National Railways.

As this diagram shows, other factors must be added to the simple factors of width and thickness :

— The so-called « *uncovered* » *or working part,* i.e. the width of the flat portion of the upper face of the sleeper in line with the rails. If this is insufficient when the sleeper is made, it must be obtained when the sleeper is adzed ready for chairs or bearing plates, and the shape and thickness of the sleeper must make this possible; semi-round sleepers should consequently be thicker.

The minimum working part stipulated is about 0.15 to 0.18 m. (5²⁹/₃₂″ to 7³/₃₂″) for sleepers of the 1st series and 0.12 to 0.13 m. (4²³/₃₂″ to 5¹/₈″) for the others.

— *The « lift »,* i.e. the height of the practically vertical parts of the side faces. This should generally be rather more than some 0.05 m. (1³¹/₃₂″).

In their specifications all the railways stipulate that the shape of all the sleepers shall conform to certain conditions, some of which are as follows :

1) Smooth lower surface;

2) Defects on upper surface limited to certain tolerances : thus the French National Railways allow certain defects provided the width of the working part where the chairs come (two strips 0.50 m. (1′7¹¹/₁₆″) long, 0.50 m. from the centre of the sleeper) is not less than that stipulated for the series of sleeper in question;

3) Ends must be practically perpendicular to the centre of the sleeper. The Swiss Federal Railways explicitely state that they must correspond with the grain of the wood;

4) Curvature limited, either to 1/50th

(¹) Somain-Anzin stipulate 0.30 m. (11¹¹/₁₆″) for certain shapes.

TABLE V.

Dimensions of wood sleepers.

Standard gauge.

Railway.	*Length.*	*Tolerances.*	*Width.*	*Tolerances.*	*Thickness.*	*Tolerances.*	*Working surface.*	*Tolerances.*	*Remarks.*
	(m.)	*(cm.)*	*(m.)*	*(cm.)*	*(m.)*	*(cm.)*	*(m.)*	*(cm.)*	
Austria	2.60	$\begin{cases}+5\\-3\end{cases}$	0.26	+ 1.5	0.16	+ 1.5	...	...	Lines in categories I & II.
	2.50	$\begin{cases}+5\\-3\end{cases}$	0.24	+ 1.5	0.15	+ 1.5	...	...	Lines in categories III & IV.
Belgium	2.60	± 5	0.28	$\begin{cases}+4\\-1\end{cases}$	0.14	$\begin{cases}+3\\-0\end{cases}$	...	...	1st. class.
	2.60	± 5	0.24	$\begin{cases}+4\\-1\end{cases}$	0.135	$\begin{cases}+3\\-0\end{cases}$	0.145	...	2nd. class.
Denmark :									
State	2.60	± 3	0.26	± 1	0.16	± 0.5	...	...	1st. class.
	2.60	± 3	0.25	± 1	0.125	± 0.5	...	...	2nd. class.
South Funen .	2.50		0.24		0.14		...	...	1st. class.
	2.40		0.20		0.15		...	...	2nd. class.
Finland	2.70		0.25		0.16		0.15	...	1st. class.
			0.22		...		0.15	...	2nd. class.
			0.20		...		0.12	...	3rd. class
France :									
S.N.C.F., Métro, Algeria, Tunisia	2.60	± 5	0.26		0.15		0.17	...	No series (Compensating tolerances.)
			0.24		0.14		0.15	...	1st. series (Compensating tolerances.)
			0.22		0.13		0.13	...	2nd. series (Compensating tolerances.)
			0.20		0.12		0.11	...	3rd. serie (Compensating tolerances.)
Somain-Anzin .	2.60	± 5	0.24 to 0.30		0.135 to 0.15		0.14 to 0.19		1st. series according to the cross section.
	2.60	± 5	0.21 to 0.28		0.13 to 0.14		0.12 to 0.16		2nd. series according to the cross section.
Holland	2.65	± 5	0.25		0.15		...	...	1st. class. (Compensating tolerances.)
	2.55	± 5	0.24		0.14		...	...	2nd. class. (Compensating tolerances.)
Italy :									
State Railways.	2.60	± 9	0.26	± 1	0.16	± 1	0.18	...	Special category : hard wood.
	2.60	± 5	0.26	± 0.5	0.16	± 0.5	0.20	...	Special category : deal.
	2.60	± 9	0.24	± 1	0.14	± 0.5	0.18	...	Special category I: hard wood.
	2.60	± 5	0.25	± 0.5	0.15	± 0.5	0.20	...	Special category I: deal.
	2.45		0.22		0.125		0.12	...	Category II: hard wood.

TABLE V. *(Continued.)*

Dimensions of wood sleepers.

Standard gauge.

Railway.	*Length.*	*Tolerances.*	*Width.*	*Tolerances.*	*Thickness.*	*Tolerances.*	*Working surface.*	*Tolerances.*	*Remarks.*
	(m.)	*(cm.)*	*(m.)*	*(cm.)*	*(m.)*	*(cm.)*	*(m.)*	*(cm.)*	
Italy : F.S. *(continued)*	2.30		0.24	± 1	0.14	± 0.5	0.14	...	4th. category lines.
North Milan .	2.51		0.22		0.13		0.13	...	
Luxemburg . . .	2.60	± 5	0.24		0.14		0.16	...	Compensating tolerance like the S.N.C.F.
Norway	2.70 to 2.40		0.25 to 0.23		0.14 to 0.11		0.16 to 0.13		According to traffic, weight of rail and sleepering, dimensions varying with the cross section.
Poland	2.60	+ 5 — 3	0.27 to 0.23		0.16 to 0.13		0.16 to 0.11		6 categories, width, thickness, working surface according to category.
Sweden : State and other railways . . .	2.70	± 5	0.21	+ 0.065 — 0.01	0.16	0	...	...	1st. series.
Swedish Rys. .	2.50	± 5	0.21	+ 0.065 — 0.01	0.15	0	...	...	2nd. series.
Switzerland :									
Federal Rys. .	2.50		0.25		0.15		0.17	...	1st. class. (Compensating tolerances.)
	2.50		0.23		0.15		0.16	...	2nd. class. (Compensating tolerances.)
			0.25		0.14		0.17	...	2nd. class. (Compensating tolerances.)
Turkey	2.60	± 5	0.27	± 1	0.14	± 1			
Jugoslavia . . .	2.60	± 5	0.26	+ 2 — 1	0.16	0	...	...	Lines in category I.
	2.30	± 5	0.25	+ 2 — 1	0.15	0	...	...	Lines in category II.
	2.30	± 5	0.22	+ 2 — 1	0.14	0	...	...	Lines in category III.
	2.30	± 5	0.20	+ 2 — 1	0.14	0	...	...	Lines in category IV.

The other railways only supplied very incomplete information on this subject.

of the length of the sleeper, or to a deflection varying from 8 cm. ($3^{5}/_{32}''$), (North Milan) to 15 cm. ($5^{29}/_{32}''$), the average being 10 cm. ($3^{15}/_{16}''$) (French National Railways).

Tolerances in the dimensions.

In the case of the length, the tolerance is usually 5 cm. ($1^{31}/_{32}''$) more or less.

In the case of the other dimensions, the specifications for each series or class give independent tolerances for each dimension, or else compensatory tolerances.

In the first case, the tolerances for width and thickness are usually of the order of 1 cm. ($^{13}/_{32}''$), + 1.5 cm ($^{19}/_{32}''$) and — 0.50 cm. ($^{13}/_{64}''$). In Belgium however + 4 cm. ($1^{9}/_{16}''$) is admitted in the case of width and + 3 cm. ($1^{3}/_{16}''$) in the case of thickness; the Swedish Railways allow + 6.5 cm. ($2^{9}/_{16}''$) on the width.

In the second case the conditions vary :

The French National Railways for example allow a reduction of 1 cm. ($^{13}/_{32}''$) in the width provided the thickness is greater by more than 0.5 cm. ($^{13}/_{64}''$) above normal for the series, or the corresponding uncovered portion is greater by more than 1 cm. In the same way, as regards thichness, a reduction of 0.5 cm. is allowed provided the width or the uncovered part is 1 cm. larger.

Such compensatory tolerances have the advantage that the cross section remains relatively unchanged in each series.

Table V gives the dimensions and the tolerances allowed on a certain number of railways, together with the resulting classification of sleepers.

Narrow gauge.

The same remarks apply. The sections are slightly less, and the average length is 1.80 m. to 2 m. ($5'10^{1}/_{8}$ to $6'6^{3}/_{4}''$). The technical specifications of the French National Railways only allow the two shapes 1 and 3 and classify sleepers for narrow gauge lines into 7 series or classes. The corresponding dimensions are given below :

Series.	L *m.*	*l* *m.*	*e* *m.*	*d* *m.*	*c* *m.*	*r* *m.*
A1	2.00	0.24	0.14	0.15	0.05	0.06
A2	2.00	0.22	0.13	0.13	0.04	0.06
A3	2.00	0.20	0.12	0.14	0.04	0.05
B1	1.80	0.24	0.14	0.16	0.04	0.08
B2	1.80	0.21	0.13	0.13	0.04	0.05
B3	1.80	0.18	0.12	0.12	0.04	0.04
C	1.30	0.18	0.12	0.09	0.04	0.04

3. *Technical conditions of the specifications.*

Hard woods. — A certain proportion of sap wood is generally allowed provided it is absolutely sound. In Belgium oak that has a red or slightly reddish tinge when freshly cut is excluded. The Swiss Railways do not allow any sap wood.

In the case of beech, which is especially subject to certain defects, timber with a reddish, grey or purple heart is

excluded. Certain railways allow a definite proportion of wood with a red heart, a tolerance which was increased during the war. Denmark for example which would only accept 15 % or 7 cm. ($2^3/_4''$) of red heart, during the war increased the percentage to 35 %.

Soft woods. — All the railways require a large proportion of heart wood :

Denmark : at least 50 %;

Swedish Railways : a minimum varying from 100 to 150 mm. ($3^{15}/_{16}''$ to $5^{29}/_{32}''$).

Rhaetian Railways : 66 %.

Certain railways report special cases in which timber is rejected : Austria rejects conifers from which the resin has been extracted; on the other hand the Swiss Federal Railways stipulated that pine trees should have been tapped; blued pine is rejected in principle, but has been tolerated since the war.

Most of the railways report the same reasons for rejection as those given in the French National Railways specifications : cupshakes, frostshakes, star shakes, bad knots, twisted fibres, pitting, splits (of a certain size). Certain railways stipulate the size of splits allowed: Rhaetian and Jugoslavian Railways — maximum length 30 cm. ($11^{13}/_{16}''$), width 5 mm. ($^{13}/_{64}''$). The Rhaetian Rys. also stipulate that split sleepers shall be bolted as soon as they are sawn, before being seasoned.

Nearly all the railways specify that the heart must be on the lower side of the sleeper, which seems to be logical.

Others such as the North Milan and Turkish Rys. report that the position of the heart is immaterial.

The curious thing is that the Italian State Rys and Swedish Railways specify that the heart shall be on the upper part. We do not know the reasons for this decision.

The trees must be felled while the sap is down during the winter, and the railways give the dates, which depend on the climate.

In somes cases however, especially in the case of oak, certain railways allow felling at any time of the year; this rule is not absolute, and exceptions may be made in certain cases where it is impossible to fell during the winter. The French National Railways are now making tests of rapid seasoning (which so far have been very satisfactory), which would make it possible to fell mountain beech trees during the summer.

The regulations regarding delivery after felling are usually fairly strict, limiting dates being given, especially in the case of beech; the French National Railways and Luxemburg Railways stipulate that beech shall be delivered before the 15th June following felling; the Belgian National Railways stipulate that beech shall be felled and delivered between the 15th September and 15th July; Denmark, that the timber shall be sawn and delivered within 3 months of being felled; the Swiss Federal Railways and Rhaetian Railways stipulate delivery within 9 months from felling, and not later than the end of July.

In the case of conifers, the regulations are easier, and delivery may be delayed as long as 2 years (Denmark).

4. *Source of supply of the sleepers.*

The countries consulted may be grouped as importing or exporting countries according to their natural resources.

Some countries have insufficient natural resources and are normally importers, such as Belgium, Holland, Denmark, Italy, Luxemburg, Switzerland and Tunisia, whereas others on the contrary are exporting countries, such as Jugoslavia (oak, conifers, and above all beech), Czechoslovakia (the same kinds), Poland (oak), Russia (all kinds of timber), and Sweden (conifers).

Other countries are more or less self-sufficient in normal years under normal conditions. France is such an one, though at certain times she has been able to export oak sleepers to Belgium, Holland and Switzerland and sleepers made from the pine trees of the Landes to Spain; after the 1914-1918 war however she had to import for the first time to make good the enormous destruction caused by the war (especially from Germany (1) as reparations), and again later on to combat the increase in home prices.

Sleepers are usually imported sawn to size and finished in the railways workshops. Sometimes however they are imported ready for use: the South Funen Railways for example import their sleepers already drilled, adzed and impregnated. Others on the contrary import logs (Rhaetian Railways).

Imports of sleepers were greatly reduced by the war, as certain importing countries were cut off from their former sources of supply, and countries which normally exported had for the most part to cope with many new demands due to the war.

The railways therefore were obliged, as they still are for the most part, to meet their sleeper requirements by exploiting the forestry resources of their own countries, which, as we have seen, sometimes means using soft woods.

5. *Making the sleepers.*

The sleepers are made in the sawmills, which are very numerous in every country (several thousands of varying size, production varying between several hundreds and several hundred thousands a year).

They are cut out either in the forest itself by long saws or by means of mobile saw-benches, or saw-benches set up in the parcel that is being felled, or in the case of large concerns in permanent saw-mills. The first method results in high quality sleepers, as the workman uses the best portions of the logs for the sleeper, though the shape may be somewhat irregular; the second method reduces hand labour to a minimum. The latter method, though involving additional transport of the logs, makes it possible to make the best possible use of the timber.

The railways usually buy such sleepers direct from the sawmills. The N. S. B. (Norway) however buys logs and saws them up in its own mills. Since the war the French National Railways have themselves purchased parcels of woodland to fell in order to increase production and reduce the cost price and competition with timber merchants. This method has given good results, overcoming the many difficulties of all kinds experienced in this period of shortage by small concerns.

Once the sleepers have been sawn to size, they are usually air seasoned (natural seasoning). The time taken varies according to the kind of wood, the condition of the wood and atmospheric conditions. It takes from 4 to 6 months in the case of oak, approximately 5 to 10 months for conifers, and 8 to 12 months for beech.

In certain countries where the climate is unfavourable, the time taken for seasoning is considerably increased (Poland, Finland, Norway) and special precautions have to be taken, such as keeping the sleepers under cover (Norway).

Some railways have reduced the time allowed for seasoning, without giving any details of the results obtained. The Somain-Anzin Railway has been content with 2 months for oak and 5 months for beech, and the Swedish Railways which use practically nothing but deal and fir are now laying sleepers straight

(1) The information in our possession shows that Germany normally imported hard wood sleepers.

away without any seasoning or impregnation.

The Jugoslavian Railways control the degree of seasoning by weighing, a standard maximum weight per cubic metre being laid down for each kind of wood.

Natural seasoning, though generally used on account of its simplicity, has nevertheless a serious drawback, which is particularly apparent under present circumstances, namely the long time it takes.

Any reduction in the seasoning time shortens the time it takes to make a sleeper, and consequently increases production; this increased production is no doubt only temporary but it is of great value at a period such as this when railways have to be restored after the war.

The Rhaetian Railways consequently normally use either furnace seasoning, or vacuum seasoning at the time of impregnation.

In the case of beech, the French National Railways since 1946 have used extra rapid air seasoning on the site that is being cleared, to enable mountainous forests that are inaccessible in winter to be felled in summer without any risk of losing the sleepers through heating when the timber has been cut with the sap up.

The process consists of sawing up the timber and stacking the sleepers crisscross a few days after the trees have been felled; this method can only be used successfully where large numbers are concerned, as it requires very careful supervision of the time taken for each stage.

Mention may be made here — though properly speaking it is not a question of seasoning — of the tests being carried out by the French National Railways of a preliminary heating of beech sleepers in steam ovens where the temperature is gradually raised to 80° C. (176° F.), in order to make it possible to impregnate the sleepers before seasoning is complete.

Some timber, such as beech, and to a lesser extent oak, split very easily when dry. To prevent this, most railways mention special precautions, such as the use of S or Z bolts (10 to 16 mm. [$^{25}/_{64}$″ to $^{6}/_{8}$″] in diameter).

Certain railways do not wait till splitting occurs but take active steps to prevent it happening; this is done in Belgium in the case of beech sleepers, and on the Swiss Federal Railways and Rhaetian Railways in the case of all sleepers (with 16 mm. bolts before the war and 12 mm. [$^{51}/_{32}$″] bolts at the present time).

Reinforcement by mild steel hoops which are put on cold after compression of the sleeper has been used recently on some railways; amongst these mention may be made of the French National Railways, Luxemburg, Norway, Poland and Jugoslavia. This method has been found very effective and better than any other; the French National Railways are considering using it in the case of all new sleepers.

6. *Adzing and drilling.*

Most of the railways do this by machinery in their shops. In the case of sleepers to be used at transitions or under track equipment where the gauge will vary from sleeper to sleeper, these operations are usually done by hand when the sleepers are laid. The French National Railways however adze and drill such sleepers by machine.

In Denmark these operations are carried out by private firms.

Some of them, however, only carry out one of these operations; for example:

— In Poland the sleepers are drilled by machine, being adzed by hand;

— The Rhaetian Railways adze the sleepers mechanically in their shops;

they are only drilled however when being laid on site.

Finally, the Swiss Federal Railways adze their sleepers in the shops, but only drill them on one side in the case of sleepers for curves.

The information supplied by the railways shows that they are tending more and more to adze and drill the sleepers in their own shops.

The French National Railways have equipped a few workshops specially for this purpose with up-to-date machinery to reduce the cost price, obtain regular machining, facilitate inspection, and meet all the requirements of the railway with great flexibility when different gauge or different types of adzing are needed.

There are two principal types of machines for cutting and drilling the sleepers :

1. Machines with horizontal knives, or to be more exact, with a 1/20th inclination, which work on the same principle as a planing machine. In these machines the shaft carrying the knives is fixed, and the sleepers move sideways, guided by a double spiked chain; the two cuts on the sleeper are made simultaneously.

After these two cuts have been made the sleeper is held fast under a group of drill which simultaneously drill all the holes for the coachscrews, 4, 6, or 8 as required.

The most up-to-date machines of this type used in some modernised shops can deal with an average of more than 200 sleepers per hour.

2. Vertical milling machines in which the tool acts as a cutter revolving round a vertical axis. This type of machine is used chiefly in mobile shops for recutting sleepers, either in temporary shops in which sleepers that can be used again are dealt with, or on the permanent way itself when the rails have been taken up. The holes for the coachscrews are drilled by vertical drills as in the case of the fixed machines after the old holes have been stopped up with pegs of appropriate shape and length in the case of sleepers to be re-used.

7. *Impregnation.*

To prevent the life of the sleepers being unduly shortened by rot or fungoid growth, most railways under normal conditions impregnate them systematically. The essential principles of this process are to dry up as much of the sap and humidity remaining in the wood as possible and soak the wood with some product intended to conserve it.

However for special economic reasons, the North Milan Railway lays its sleepers without treating them; the Jugoslavian Railways do likewise in the case of oak sleepers on standard gauge lines, while the Swedish Railways do not impregnate a large part of their deal sleepers, in the case of those laid in the north of the country, i.e. those made of good quality wood likely to last well (diameter of heart wood more than 150 mm. [$5^{29}/_{32}$"]).

The Tunisian Railways who did not impregnate their sleepers before the war, now treat them with creosote imported from the U.S.A.

Antiseptic products used.

The qualities required of impregnating products may be classified in the following order :

1) maximum antiseptic strength which will remain constant and not be washed out;

2) easy to apply, which will penetrate the wood evenly throughout its bulk;

3) having no effect on the mechanical properties of the wood;

4) which will not affect the metal parts in contact with the sleeper : rail, bearing plate or chair, coachscrews;

5) have no toxic qualities liable to injure the staff handling sleepers on the permanent way;

6) conserve the dielectric properties of the wood.

Historically speaking, bichloride of mercury was the first product used to impregnate timber, by Homberg at the beginning of the 18th. century.

Towards the middle of the same century, pyrolignite was used, which has recently returned to favour. Creosote was only used by Boucherie towards 1830, at the same time as sulphate of copper.

About the same time zinc chloride was used, which is an excellent antiseptic, but has the drawback that it gets washed out and also removes the insulating property of the wood.

Sulphate of iron has also been used, but this destroys the fibres of the wood.

Finally, especially since the great expansion of the railway at the end of the 19th. century, by far the best product for impregnation has been found to be a tar oil product known as « creosote ».

Its remarkable anti-fungoid properties are due to the heavy anthracenic oils which are distilled between 170 and 350° C. (338° to 662° F.) with a variable proportion of lighter fractions which enable a suitable fluidity to be obtained.

In most countries there are technical specifications for creosote relating on the one hand to its physical characteristics : specific weight, fluidity at a given temperature, absence of matter in suspension, fractional distillation tests; and on the other to its chemical composition : water content, phenol content and naphtaline content, and solubility in benzol.

The values specified for these characteristics by the different railways are very similar.

For example the French Railways require :

— specific weight at 40° C. : 1.005 to 1.080 (other railways allow a little more);

— total fluidity at 40° C. (at 25° C. in Holland);

— deposit at 40° C. less than 0.5 % in weight;

— fractional distillation :

at 150° C. less than 0.5 % in weight;

at 200° C. less than 4 % in weight;

at 235° C. less than 40 % in weight;

residue at 315° C. less than 40 % in weight.

(In Belgium only 30 % and in Holland and Italy only 25 % residue at 315° is allowed.)

Water content : 1 %.

Phenol content : from 3 to 12 % in volume out of the residue at 250° C.

Naphtaline content : from 7 to 20 % in weight out of the residue at 250° C.

(In Belgium from 15 to 30 %).

Solubility in benzol : residue less than 0.2 % in weight.

Apart from creosote, metal salts are used, the most commonly used being :

a) pure zinc chloride : The Austrian Railways define the main solution at 50° Baumé for preparing the impregnation solution (3° Baumé in Jugoslavia) as not containing more than 1 % of iron but standardised at least 23 % of zinc.

b) sulphate of zinc generally associated with arsenical anhydride (Boliden salt) used especially in the case of conifers (Sweden), and *sulphate of copper* used in France to treat pine from the Landes;

c) during the war certain railways used different mixtures of salts invented by the Germans and sold under various names, which contain in particular either salts of zinc, or fluoride of sodium or a mixture of sodium fluoride, dinitrophenol, arsenate of soda, salt of chromium (trialith, osmolit, basilit, etc.);

d) finally, amongst the products

which appeared during the war to take the place of creosote, those which gave the best results are *zinc pyrolignites* obtained by distilling the pyrolignous juices from wood and treating them with oxide of zinc.

Better results still have been obtained by the addition of arsenical anhydride to the pyrolignites.

It should be noted that products with a metal salt basis and pyrolignous juices diminish the electric resistance of the wood to a considerable extent, especially in the case of beech sleepers which absorb a very large quantity of the product.

Process of impregnation.

Various processes have been reported by the railways :

1. Simple immersion cold.

Lower Congo-Katanga : immersion in an arsenical solution followed by painting with hot tar.

Algeria : immersion in a cold carbonileum bath for 2 hours, 3 kgr. (6.613 lbs.) per sleeper being absorbed.

Tunisia : immersion for 1 hour in a creosote bath, absorbing 2.150 kgr. (4.739 lbs.) per sleeper.

2. Simple immersion hot.

Chemins de fer Economiques du Nord, boiled for 8 hours in creosote, 2.500 kgr. (5.511 lbs.) of which is absorbed per sleeper.

3. Bethell Process — (Also known as « Vacuum and pressure process »).

For this an autoclave cylinder is used which may be as much as 25 to 30 m. (82′¼″ to 98′5⅛″) long, holding as many as 400 sleepers at a time.

First of all the cylinder is subjected to a vacuum of 60 cm. (1′11⅝″) of mercury for about half an hour. At the end of this period the creosote is added hot (about 85°) and the pressure is increased to 9 atmospheres at which it is maintained until saturation is complete, which takes about one hour.

This process during which the wood cells, which have been emptied by the effects of the vacuum are filled with creosote, enables a large quantity to be absorbed.

It is used more particulary for oak sleepers on some systems such as Luxemburg, the French National Railways and the Paris Metro, the amount of creosote absorbed being at least 4.500 kgr. (9.920 lbs.) per oak sleeper.

Certain railways, in particular the Jugoslavian Rys, use a variant of this process for beech sleepers of inferior quality, using zinc chloride as antiseptic — (temperature 60°, pressure 3 atmospheres, length 30 minutes).

3. *Ruping Process.* — This also makes use of an autoclave, its chief characteristic being the preliminary use of air pressure to open the pores of the wood and fill them with compressed air.

The antiseptic is then introduced under a still higher pressure, then extracted by vacuum under the action of the compressed air previously stored up which partly repels it, so that only sufficient is left to coat the cell walls without filling them completely. This process therefore makes a saving in the amount of antiseptic used, particulary in the case of porous wood — (beech and soft woods).

The initial air pressure and the time it is maintained vary, and depend upon the kind of wood being treated : for example in Belgium, in the case of oak, fir and beech, the pressure is 4 atmospheres for 10 to 15 minutes; in Holland for pine it is 2.5 to 4 atmospheres for 15 minutes and for oak 1 to 1.25 atm. for 15 minutes.

The pressure during the second period, after the antiseptic has been introduced also varies widely (8 to 15 atm. and 1 to 4 hours) according to the railway and kind of wood, and the tem-

perature, for creosote, is about 85°. The Polish Railways report that it is 85° in winter and 70° in summer.

The final vacuum is generally from 60 to 70 cm. (1'11⅝" to 2'3½") of mercury for 15 to 30 minutes.

The amount of creosote absorbed, which varies a lot according to the kind of wood and its quality, per sleeper is of the order of :

2.500 kgr. to 3 kgr. (5.511 to 6.613 lbs.) for oak; (the French National Railways stipulate 4.5 kgr. for sleepers of the 1st series).

5 to 9 kgr. (11.023 to 19.841 lbs.) for conifers.

As for beech which is both difficult to impregnate and easily rots, certain Railways treat it twice in succession according to the process known as the « double Ruping ». The absorption of creosote must be 190 kgr. (418.878 lbs.) per m^3 of wood treated, i. e. about 15 kgr. (33 lbs.) per sleeper.

Certain special treatments have also been reported :

The Austrian Railways use the so-called « mixed » process in the case of larch, consisting of injecting a mixture of creosote and zinc chloride (6 kgr. [13.227 lbs.] per sleeper) and in the case of beech « double » process, i.e. a first impregnation with zinc chloride followed by one of creosote, 20 kgr. (44 lbs.) of zinc chloride solution and 12 kgr. (26.455 lbs.) of creosote being used per sleeper.

Finally the Jugoslavian Railways report a « combined method » for beech : vacuum at 60 cm. for 30 minutes, injection of a solution of zinc chloride (3 degrees Baumé) under a pressure of 3 atm. at 60° for 30 minutes, then vacuum for 15 minutes followed by an injection of creosote at 90° for 2 hours at a pressure of 9 atm., and finally a vacuum for 10 minutes.

Figures 1 to 4 give a graphical representation of the different processes : Bethell, Ruping, double Ruping and Jugoslavian combined process.

Effects of the war on methods of impregnation.

During the war, owing to the shortage of creosote due both to its utilisation by war industries and the reduction of imports, many European railways were obliged to investigate new methods or new processes, and in most cases were forced to modify their methods to make these more economical.

In this way, the use of products replacing creosote certain of which were mentioned above, came about :

— zinc chloride (Austria, Belgium, Denmark, Somain-Anzin, etc.);

— copper sulphate (for pine in France);

— compound salts and special substitute products (Wolman salts in Holland and Jugoslavia, Bolidan salts in Sweden; Basilit in Switzerland and France, Landyle in France, a mixture of zinc chloride and sodium fluoride in Algeria, etc.).

Likewise, the methods used for injection derived from the Bethell or Ruping processes were adapted to the new products being used (especially as we have seen in Austria and Jugoslavia).

On the other hand, certain railways continued to use creosote, but adapted their methods to economise it :

— the Paris Metro substituted the Ruping process for the Bethell process for its oak sleepers, limiting absorption to 2.4 kgr. (5.290 lbs.) per sleeper;

— the Rhaetian, Italian and other railways have simply limited the amount of creosote used for all kinds of sleepers to a small amount (2 to 3 kgr. [4.409 to 6.613 lbs.] per sleeper).

Finally, certain railways such as the French National Railways and the Swiss Federal Railways, whilst extending the use of subsitute products, have

Temperature of the creosote :

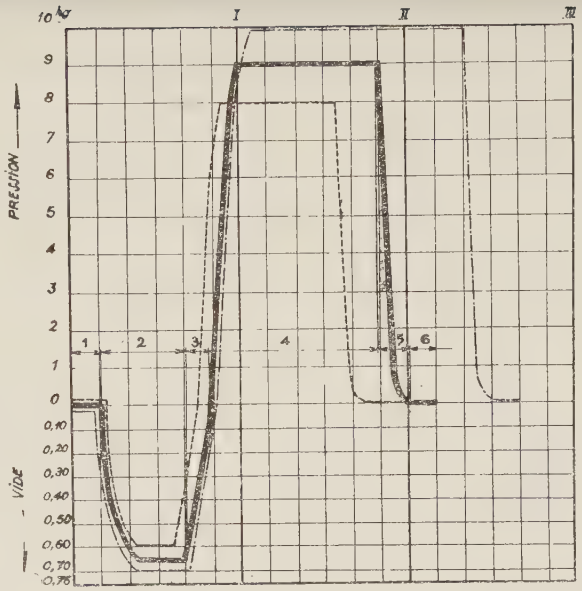
In the impregnating cylinder : 80° to 90°.

Explanation :

Curve showing average times taken. Pressure and vacuum shown at average values used.

Curve showing minimum times. Vacuum pressure at minimum values allowed.

Curve showing maximum times. Pressures at maximum values stipulated. Vacuum at maximum value attainable in practice.



Absorption of creosote :

Difference in weight after at least 30 minutes absorption and weight before being put into the cylinder :

Per cu. metre of wood 70 kgr.(1)

Per sample sleeper :

No series	6 kgr. 6
1st. series	5 kgr. 6
2nd. series	4 kgr. 7
3rd. series	4 kgr.

The above absorption corresponds to the real minimum volume. One sleeper is then cut up :

No series	0.095 m³.
1st. series	0.081 m³.
2nd. series	0.068 m³.
3rd. series	0.057 m³.

(1) Varies according to the amount of sapwood.

Fig. 1. - Impregnation of oak sleepers by the Bethell process.

Ref. No.	*Identification of the stage.*	*Average length of time.*	*Remarks.*
1	Loading the cylinder	10′	
2	Vacuum of 0.65	30′	Minimum 25 minutes.
3	Filling with hot creosote	10′	
4	Compression of the creosote (pressure lying between 8 and 10 kgr.)	1 h. 00′	Until no more is absorbed (i.e. when the level of creosote remains constant for 5 minutes under pressure).
5	Emptying the cylinder	10′	
6	Unloading the cylinder	10′	
	Average length of a treatment	*2 h. 10′*	

Temperature of the creosote :

In the feed cylinder . . } 85 to 95°
In the working cylinder. }

Explanation :

Curve showing average times taken. Pressure and vacuum shown at average values used.

Curve showing minimum times. Vacuum pressure at minimum values allowed.

Curve showing maximum times. Pressures at maximum values stipulated. Vacuum at maximum value attainable in practice.

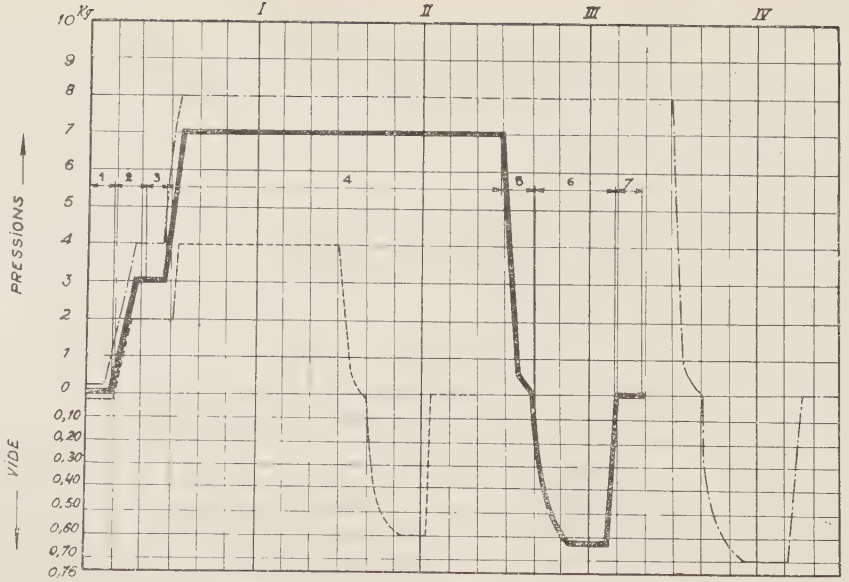


Fig. 2. — Impregnation of oak sleepers by the Ruping process.

Absorption of creosote :

Difference between the weight on being taken out and weight on being put into the cylinder + the weight of liquid absorbed in the condenser.

Per cu. m. of wood 30 kgr.(1)

Per sleeper :

No series . . . 28 kgr.
1st. series . . . 24 kgr.
2nd. series . . . 2 kgr.
3rd. series . . . 1 kgr. 7

The above mentioned amounts correspond to the minimum real volumes below, one sleeper being cut up :

No series . . . . 0.095 m³.
1st. series . . . 0.081 m³.
2nd. series . . . 0.068 m³.
3rd. series . . . 0.067 m³.

(1) Varying according to the amount of sapwood.

Ref. No.	Identification of the stage.	Pressure. Minimum.	Pressure. Normal.	Pressure. Maximum.	Length of time. Minimum.	Length of time. Normal.	Length of time. Maximum.
1	Loading the cylinder . .	...	...	...	...	10′	»
2	Air pressure	2 kgr.	3 kgr.	4 kgr.	10′	10′	»
3	Filling with creosote under pressure	d°	d°	d°	»	10′	»
4	Compression of the creosote	4 kgr.	7 kgr.	8 kgr.	1 h. 00′	2 h. 00′	3 h. 00′

Ref. No.	Identification of the stage.	Length of time. Minimum.	Length of time. Normal.	Length of time. Maximum.
	Brought forward .		2 h. 30′	
5	Emptying the cylinder .	»	10′	»
6	Vacuum and recovery of the creosote	25′	20′	35′
7	Unloading the cylinder .	»	10′	»
	Average length of a treatment		*3 h. 20′*	

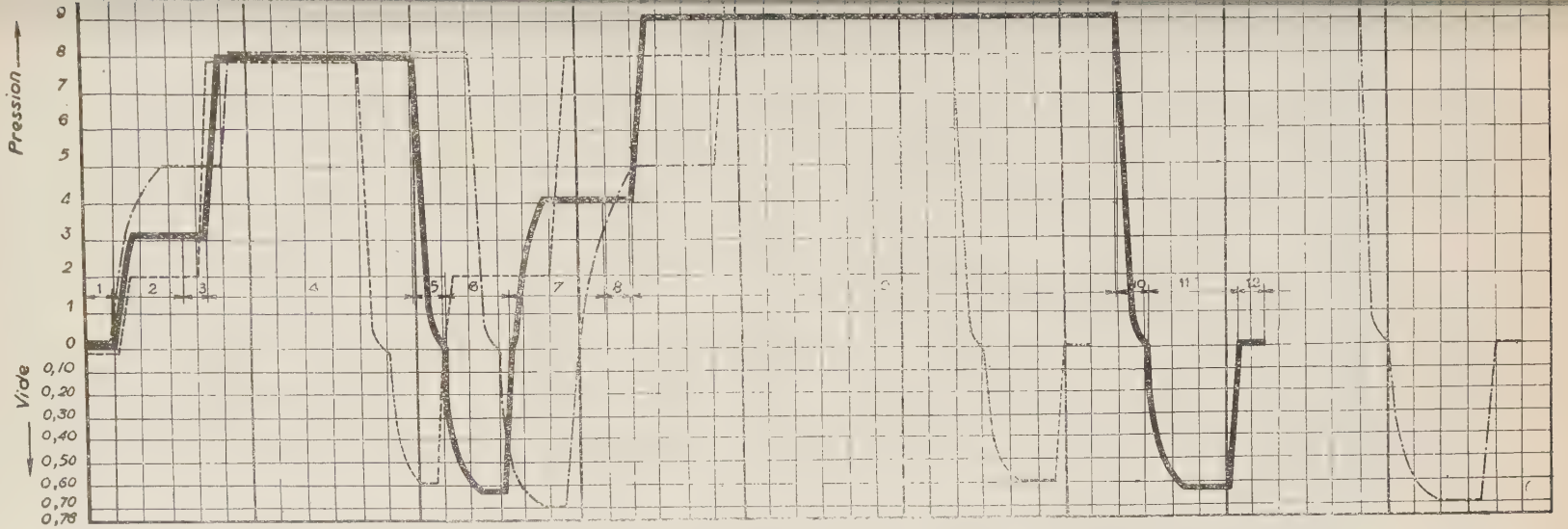


Fig. 3. — Impregnation of beech sleepers by the double Ruping process by the French National Railways.

Temperature of the creosote :

In the feed cylinder : 85 to 95°.

In the working cylinder : 95°.

Explanation :

Curve showing average times taken. Pressure and vacuum shown at average values used.

Curve showing minimum times. Vacuum pressure at minimum values allowed.

Curve showing maximum times. Pressures at maximum values stipulated. Vacuum at maximum value attainable in practice.

Details of the treatment :

Ref. No.	Identification of the stage.	Pressure or vacuum to be applied. Minimum.	Normal.	Maximum.	Length of time for each stage. Minimum.	Normal.	Maximum.
1	Loading of the cylinder . . .	»	»	»	»	10′	»
2	Air pressure	2 kgr.	3 kgr.	5 kgr.	20′	25′	30′
3	Filling with creosote under pressure	d°	d°	d°	»	10′	»
4	Compression of the creosote .	»	8 kgr.	»	1 h. 00′	1 h. 15′	1 h. 30′
5	Emptying the cylinder . . .	»	»	»	»	10′	»
6	Vacuum and recovery of the creosote	0.60	0.65	»	20′	25′	30′
7	Air pressure	2 kgr.	4 kgr.	5 kgr.	30′	35′	40′
8	Filling with creosote under pressure	d°	d°	d°	»	10′	»
9	Compression of the creosote .	8 kgr.	9 kgr.	10 kgr.	»	3 h. 00′	4 h. 00′
10	Emptying the cylinder . . .	»	»	»	»	10′	»
11	Vacuum and recovery of the creosote	0.60	0.65	»	30′	35′	40′
12	Unloading the cylinder . . .	»	»	»	»	10′	»
	Average length of a treatment	...	...	...	...	7 h. 15′	

Absorption of creosote :

Difference between the weight on being taken out and weight on being put into cylinder + the weight of liquid absorbed in the condenser.

Per cu. m. of wood: 175 to 205 kgr. (average: 190 kgr.).

Per sleeper :

No series 18.000 kgr.
1st. series 15.400 kgr.
2nd. series 12.900 kgr.
3rd. series 10.800 kgr.

The above mentioned amounts correspond to the minimum real volumes below, one sleeper being cut up :

No series . 0.095 m³.
1st. series . 0.081 m³.
2nd. series . 0.068 m³.
3rd. series . 0.057 m³.

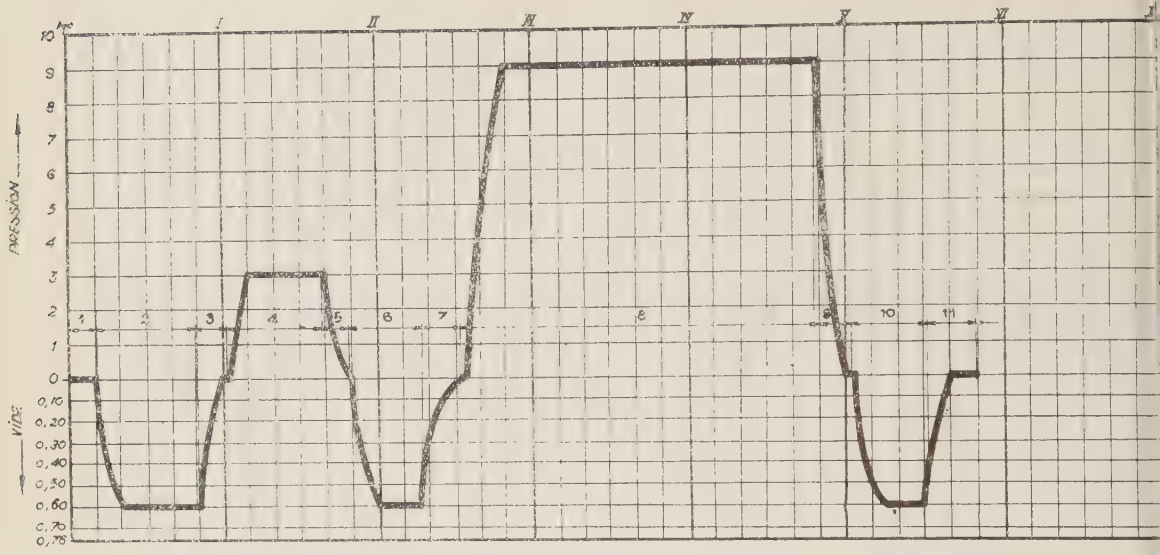


Fig. 4. — Impregnation of beech sleepers by the Jugoslavian « combined » process.

Details of the treatment :

Ref. No.	*Identification of the stage.*	*Pressure or vacuum to be applied.*	*Length of time.*
1	Loading the cylinder	...	10′
2	Vacuum applied to the wood	0.60	30′
3	Filling a cylinder with a solution of Cl^2Zn at 3° Baumé, temperature 60° C. . . .	...	10′
4	Impregnation under pressure	3 kgr.	30′
5	Emptying the cylinder	...	10′
6	Vacuum applied to the wood. Impregnation with Cl^2Zn solution and recovery of the solution	0.60	15′
7	Filling the cylinder with creosote at 90° C.	...	10′
8	Impregnation under pressure	9 kgr.	2 h. 00′
9	Emptying the cylinder	...	10′
10	Vacuum applied to the wood, impregnation with creosote, and recovery	0.60	10′
11	Unloading the cylinder	...	10′
	Average length of a treatment . .		4 h. 25′

Explanation :

Curve showing average times. Pressure and vacuum at average values used.

preferred to use the small amounts of creosote available for the woods which rot most easily, such as beech, using the most durable sleepers, such as those made of oak, without impregnating them.

The experience obtained with methods due to war conditions is too limited to enable their results to be judged as yet. It is not impossible however that some of these methods will prove of value, at least for certain kinds of wood or certain classes of sleepers, and the research work inspired by the war may lead in the future to other methods at least as good as the classic one of impregnating with creosote. Especially if, as seems likely, the latter finds new outlets in the chemical industries as it found them in the war industries.

Impregnating shops.

The impregnating of sleepers usually takes place in certain large installations where drying air is available, in which the sleepers from the mills are stacked in close piles, according to the wood and category.

The sleepers are usually adzed and drilled in these shops before they are impregnated, at the same time as they are marked to show the year and category or type (gauge, width of bearing surface for chairs or bearing plates).

Preliminary cutting (which is very rare; it was only reported by Denmark) or the drilling of the diffusion holes (three 12 mm. [$^{15}/_{32}''$] holes, reported by Belgium) also takes places in these shops.

These impregnating shops belong either to the railways themselves, or to private firms; frequently both kinds are found side by side in the same country.

For example the French National Railways treat 60 % of their sleepers in their own shops.

The Rhaetian Railways and Austrian Railways have all their sleepers impregnated by private firms, whereas in Belgium and Jugoslavia all the sleepers are treated in the railway shops.

Two Administrations, the Swedish and Italian State Railways, report the existence of mobile plants, fitted on a train, which are brought to the neighbourhood of depots where are sleepers to be impregnated. Unfortunately they gave no details of the results of this method, justified by special local conditions or the difficulty of transporting the sleepers twice.

Control of impregnation.

Whether impregnation takes place in shops belonging to the railway or to private firms, it is essential to control the amount of the product absorbed by the sleepers. These amounts which are laid down in the specification are controlled in two ways :

— by volume, by gauges fitted on the plant itself;

— by weight, by weighing the sleepers before and after treatment (taking into account the water extrated when using the Ruping process);

— or both methods together.

The French National Railways stipulate not only that the amounts actually injected lie between certain limits, but that the conditions of injection conform with their standards : for this the temperatures and volumes of liquid, the pressures and times must be automatically recorded on control diagrams.

Certain railways control the degree of impregnation either by taking core samples (French National Railways, Belgium, Denmark, Rhaetian Railways...), or by longitudinal cuts (Italy, French National Railways).

The practical results of antiseptic treatment are usually checked on the permanent way by means of the date marks which show not only the year but the plant at which the sleeper was treated, and consequently the method used. The Italian Railways report that

they keep a special check on the behaviour in service of sample sleepers which have been carefully marked.

Such control is only effective a long time after the sleepers have been treated; consequently an artificial method of producing rot is used in Belgium.

Influence of antiseptic products on the resistivity of sleepers.

The railways all agree in recognising that whereas impregnation with creosote has a tendency to increase the resistivity of sleepers, impregnation with metallic or hydrolysable salts reduces it to varying degrees.

The Swiss Federal Railways, in particular, gave the results of tests carried out with oak and beech sleepers, wet or dry, impregnated with basilite and with creosote. The resistivity of standard gauge dry oak sleepers is 24 000 to 28 000 ω and increases up to 160 000 to 400 000 ω for creosoted sleepers, but falls to 25 000 ω for beech injected with creosote and 5 000 ω for wet beech injected with basilite.

The substitute products for creosote now used therefore should not be used in the case of sleepers to be laid on track fitted with track circuits.

8. *Fastening rails to wood sleepers.*

We will not dwell on the way bull-headed rails are fastened, as the use of these is constantly decreasing; they always rest on the sleeper by means of a chair which also holds them in place when a wooden or steel key is inserted which acts as a spring.

The flat-bottomed rail can be laid in several ways :

— directly on the sleeper, with or without a protecting bearing plate;

— on a metal bearing plate with a single fastening;

— on a metal bearing plate with a separate fastening.

Laid direct on the sleeper.

This is the most usual method as it is the simplest. The wear of the fastening is relatively rapid however, as the pressure of the rail only bears on a relatively small surface, and the fastenings have to be tightened up periodically and maintenance carefully carried out. This method of laying the rails is only used with hardwood sleepers on main lines.

The sleepers are generally adzed at a slope of 1 in 20, the gauge of the track being maintained by shoulder pieces (Fig. 5).

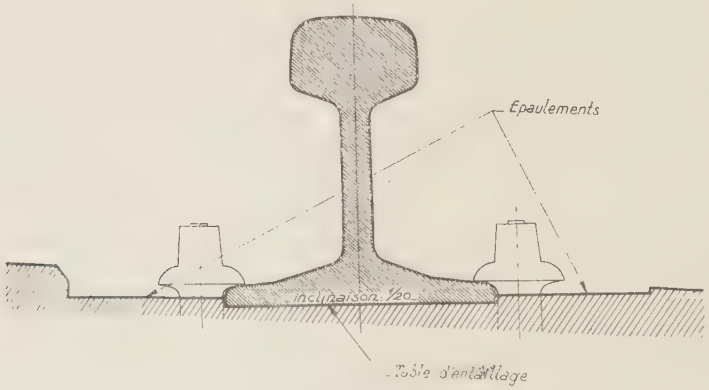


Fig. 5 — Rail laid directly on wood sleeper.

Explanation of French terms :

Epaulements = shoulder pieces. — Table d'entaillage inclinaison 1/20 = rail bearing surface inclination 1 in 20.

However, certain railways, such as the North Portugal and the Indo-China Railways use sleepers on which the fastenings have no shoulder pieces, the gauge being maintained solely by coachscrews or spikes. This method is undoubtely inadequate in the case of track run over by fast, heavy traffic.

The actual fastening of the rail is assured either by coachscrews or spikes, generally 3 per plate, two on the inside and two on the outside alternatively, arranged in V or better still L formation.

The French Railways used this simple method for a long time, without bearing plates, on hardwood sleepers, using 3 coachscrews in L on all categories of line. They now only use it on lines with average or little traffic.

Laid on metal bearing plates with direct fastenings (Fig. 6).

As axle loads and speeds increased, many railways adopted this type of fastening in order to reduce maintenance costs and the wear on sleepers.

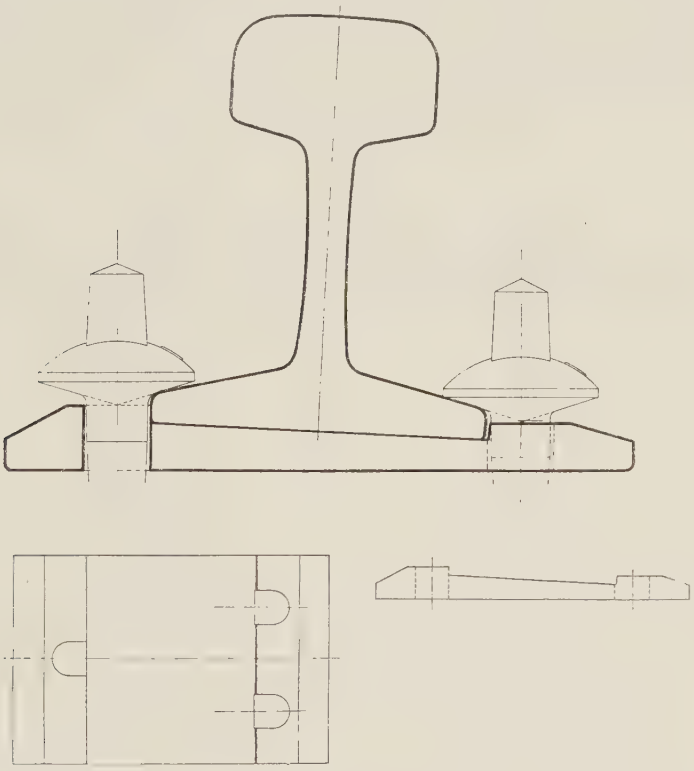


Fig. 6. — Rail laid directly on wood sleeper with metal bearing plate.

Certain systems limit the use of bearing plates with hardwood sleepers to heavily loaded lines (this is so on the French National Railways), or to curves, the better to meet lateral stresses or unevenly distributed pressure on the bearing surfaces (this is the case in particular in Belgium, if the radius of the

curves is less than 1 000 m. [3 280′]; the « Chemins de fer Vicinaux » use a bearing plate on every third sleeper when the radius is less than 150 m. [492′]; in Luxemburg and Tunisia in the case of highly stressed curves; in Turkey on curves of radius less than 400 m. [1 312′], etc.).

Finally, whereas certain systems such as Denmark only use bearing plates generally in the case of softwood sleepers, others use them systematically, for example, Switzerland, Czechoslovakia, Jugoslavia, Italy, and Belgium in the future.

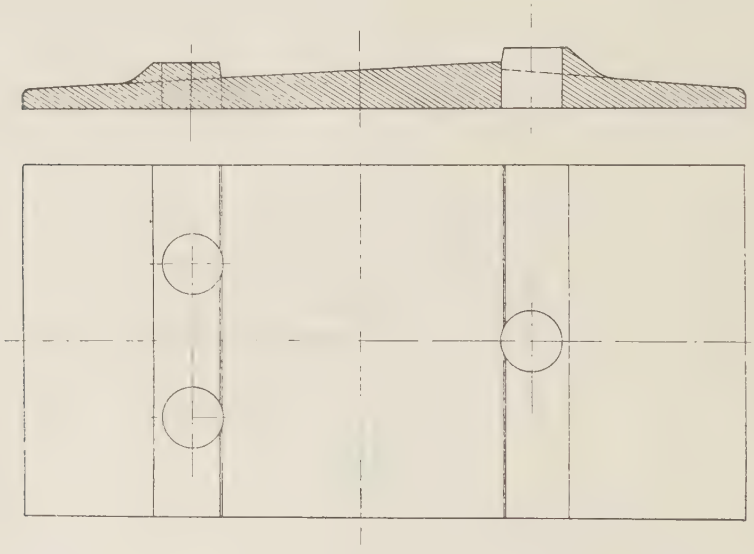


Fig. 7. — Metal bearing plate used by the Swiss Federal Railways.

It should be noted, however, that the Swiss Federal Railways had to give up using bearing plates during the war owing to the shortage of steel, and they have also given up using them in tunnels where corrosion takes place too quickly.

The bearing plates used are rectangular plates made of rolled steel. They include shoulder pieces intended to support the rail laterally; as a general rule the bearing surface of the plate alone has an inclination of 1 in 20 (Italy, Norway, Sweden, Jugoslavia, Switzerland, Czechoslovakia); however on certain railways, in particular the French National Railways, the inclination is given by adzing the sleeper, the bearing surface of the rail being parallel to the lower surface of the bearing plate.

The dimensions of the bearing plates are so calculated that they multiply the bearing surface of the rail by a coefficient lying between 2 and 3. The bearing plate used by the Swiss Federal Railways has the following dimensions : length 325 mm. (12.795″) (for a rail with a 125 mm. [4.921″] foot), width 160 mm. (6.299″) (corresponding to that of the minimum working part of the sleeper), thickness: minimum 8 mm. ($^{5}/_{16}$″) under the foot 14 to 20.35 mm. ($^{35}/_{64}$″ to $^{51}/_{64}$″) (Fig. 7).

The bearing plates are fixed to the sleeper by the same fastenings as the

rail. These fastenings are either coachscrews or ordinary spring spikes, and the method is identical with that used in the case of fastenings without bearing plates.

Laid on bearing plates with indirect fastenings.

Certain railways have endeavoured to improve the method of fastening the rails still further by using metal bearing plates fastened directly to the sleeper and carrying and supporting the rail by means of independent fastenings; this is the case in particular in Czechoslovakia, Jugoslavia, Norway, Luxemburg, and Italy.

A metal bearing plate the dimensions of which are similar to those used in the case of direct fastenings (305 mm. [12.007″] for example in Czechoslovakia with T arrangement) is fixed to the sleeper by means of coachscrews or spikes (4 as a rule, two on each side of the rail — sometimes 3). The bearing plate on the rail is inclined at 1 in 20 and the bearing plate is laid flat on the sleeper (Fig. 8).

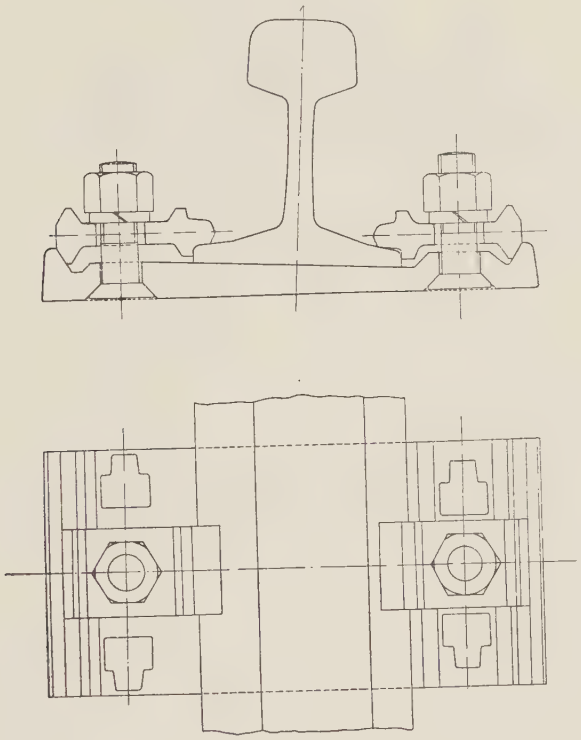


Fig. 8. — Use of metal bearing plate with indirect fastening to wood sleeper — Czechoslovakia.

Steel sleeper clips fixed to the bearing plates by bolt, nut and Grover washer hold the rail on the bearing plate.

The lateral fastening of the rail is assured either by the point of the clip gripping the flange vertically and per-

pendiculary to the track (as in the case in the arrangement used in Italy for the F.S.P. type of track [Fig. 9] and Czechoslovakia [Fig. 8]), or by the shoulder pieces of the bearing plate (type K 49 track of the Italian State Railways and Jugoslavia [Fig. 10]). In the first case the boss of the bearing plate prevents the clips from getting out of place and a series of different clips makes it possible to adapt the length of their nibs to the different widths of rail flange and different gauges of the track. In the second case, on the contrary, there is a special type of bearing plate for each type of rail and the gauge is regulated by the position of the bearing plate on the sleeper, the clips used being the same in every case.

Finally, mention may be made of the method used in Norway on the Bergen line; the bearing plate is fastened to the sleeper by means of coachscrews, the clip is held in slides on the bearing plate by a key nailed to the sleeper (Fig. 11).

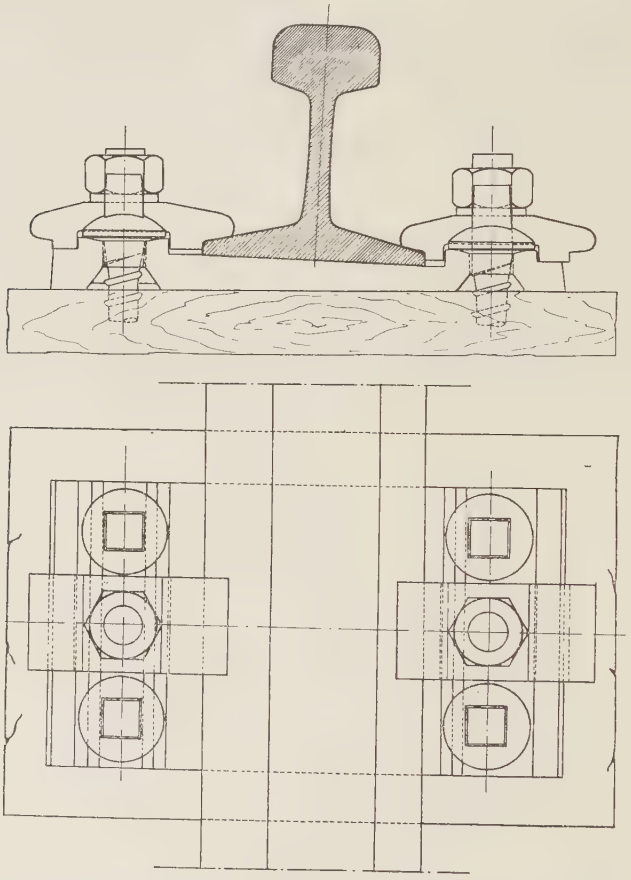


Fig. 9. — Use of metal bearing plate with indirect fastening to the sleeper — Italy, F.S.P. type.

The railways using this complicated and costly type of fastening recognise its advantages, which in theory are incontestable : increase in the weight, rigidity and inertia of the track, maintenance of an effective highly stressed form of tightening up, which prevents the rail being displaced relatively to the sleeper, all of which are essential in the case of long rails with fewer joints.

These methods, however, similar to that used in Germany when laying 49 kgr. (108 lbs.) rail on K track, have not been used for a sufficiently long period to prove that the saving in maintenance costs will make up for the higher first cost. Certain railways have therefore limited them to certain definite cases, for example in Italy to type 49 track; in Czechoslovakia and Jugoslavia special devices are used at rail joints (a single bearing plate being fastened by means of coachscrews to the two sleepers on each side of the joint) and in Italy in the case of F.S.P. track when the radius is less than a certain amount (2 000 or 600 m. [6 561′ or 1 968′] according to the category of line), or the gradient

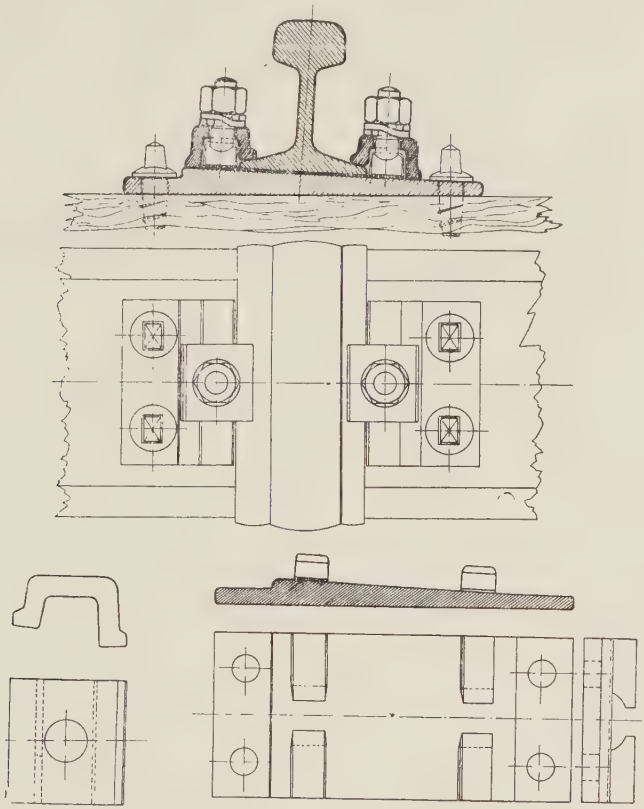


Fig. 10. — Laid on metal bearing plate with indirect fastening to the sleeper — Italy, type K 49, and Jugoslavia.

more than 15 °/₀₀, one sleeper in three is fitted with independently fastened bearing plates, the two others having ordinary bearing plates.

Filler pieces.

To protect the wood or limit the wear on bearing plates and chairs caused by the foot of the rail, and to make track laid on bearing plates more supple and less noisy, wood, rubber or plastic filler pieces are commonly used (Italy, Switzerland, Czechoslovakia, French National Railways). The elasticity of these fillers which are under constant pressure from the tightening up of the fastenings makes the latter more effective and lasting.

Information regarding fillers will be found in the chapter on « Maintenance », more particularly in the case of metal and concrete sleepers.

Coachscrews and spikes.

Whatever method of fixing the rail on the sleeper be used, with or without bearing plates, it is fastened to the wood of the sleeper by means of coachscrews or spikes. Many railways use both together, whilst others, such as the Belgian Railways and French National Railways only use coachscrews.

The size of the coachscrews used varies from one system to another (minimum diameter 16 [⁵/₈″] — maximum 26

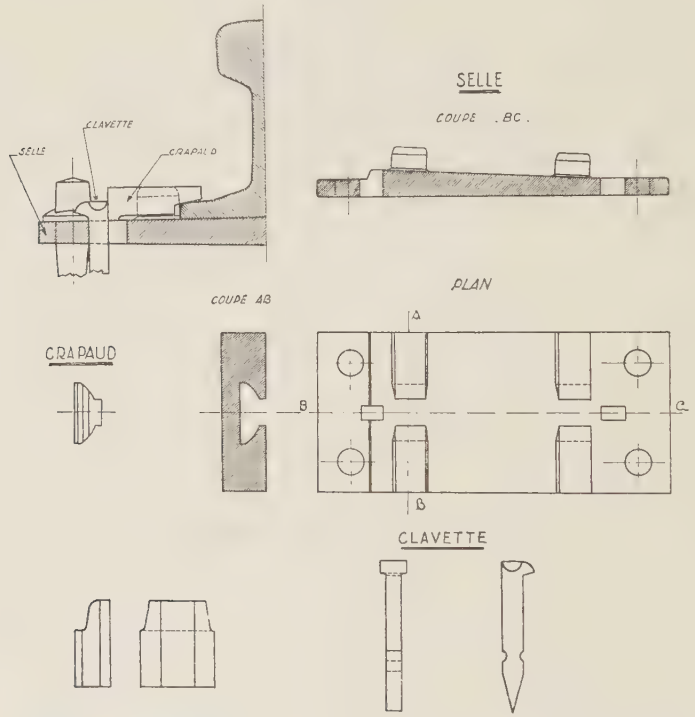


Fig. 11. — Laid on metal bearing plate with indirect fastening to the sleeper — Norway.

[$1^{1}/_{32}$"]; minimum length 105 [$4^{9}/_{64}$"] — maximum 196 [$7^{47}/_{64}$"]). Details are given in Table V. For example, the French National Railways, besides the old regional types, which have now been given up, have standardised four types of coachscrews, the diameter of which is 23 or 26 mm. ($^{29}/_{32}$" or $1^{1}/_{32}$") and the length 120 or 140 mm. ($4^{23}/_{32}$" or $5\frac{1}{2}$"). The 23 mm. coachscrews are used when new track is laid, and the 26 mm. ones during maintenance operations when the holes have been enlarged by wear. The 140 mm. coachscrew is the one usually used, the 120 mm. one being used in the case of sleepers of reduced thickness to prevent them touching the ballast and thus decreasing the insulation in the case of lines equipped with track circuits.

The sleepers are bored with augers of smaller diameter than the coachscrews to be used, the softer the wood the smaller the size of auger used. Thus in the case of 23 mm. coachscrews, the French National Railways drill 16 to 17 mm. ($^{5}/_{8}$" to $^{43}/_{64}$") holes in hard wood and 15 to 16 mm. ($^{19}/_{32}$" to $^{5}/_{8}$") in deal; in the case of 26 mm. coachscrews these diameters are 17.5 to 18.5 and 16.5 to 17.5 mm. ($^{44}/_{64}$ to $^{46}/_{64}$" and $^{42}/_{64}$" to $^{44}/_{64}$") respectively. The North Portuguese Railways have fixed the diameters of the holes relatively to those of the coachscrews at $^{5}/_{8}$ in case of deal and $^{11}/_{16}$ in the case of oak or eucalyptus.

The spikes used are generally rectangular in section, sometimes octagonal, varying according to the railway from 12 × 16 to 20 × 20 ($^{15}/_{32}$" × $^{5}/_{8}$" to $^{25}/_{32}$" × $^{25}/_{32}$"); their length varies from 130 to 185 mm. ($5^{1}/_{8}$" to $7^{19}/_{64}$"); Finland however reports the use of 210 mm. ($8\frac{1}{4}$") long spikes in the case of track particularly exposed to frost.

The spikes are driven directly into softwood sleepers, while in the case of hardwood sleepers a hole is bored to take them, the diameter of which is of the order of $^{6}/_{10}$ of the smallest section of the spike (Polish regulations) and 6 to 10 cm. ($2^{3}/_{8}$ to $3^{15}/_{16}$") deep.

The tightening obtained by using ordinary coachscrews and spikes does not last long; to remedy this serious drawback certain railways (Switzerland, Sweden, Italy) are making a trial of elastic spikes the head of which, in the form of a cross, bears constantly on the rail flange with a force stated to be 500 to 600 kgr. (1 102 to 1 322 lbs.) on the Swedish State Railways.

Table VI gives details of the extent to which the different methods of fastening are used on the various railways, and the dimensions of the coachscrews and spikes currently used.

9. *Kind of ballast used with wood sleepers.*

An investigation into the quality of ballast that should be used in the case of the different categories of track is outside the scope of the present report. We thought it interesting, however, to ask the railways what restrictions they had found necessary in the case of different sorts of sleepers.

In the case of wood sleepers, the railways in fact use all kinds of ballast : broken stone, pebbles or crushed pebbles, sand, none of which have any ill-effects on wood sleepers (except perhaps broken stone of more than 80 mm. the use of which has now been given up). On the other hand dirty or earthy ballast of any kind holds too much moisture and gets overgrown too soon, so that it encourages rot in the wood and soon has to be cleaned or renewed. The levelling of muddy track is moreover very unstable and irregular, which results in abnormal wear of the rail and sleepers, and leads to a rapid loosening of the fastenings and heavy mechanical wear on the bearing plates under hammer blows from the rails.

SECURING THE

Data concerning up-

	Rail directly fastened to sleeper. %	*Bearing plates.* %	*Filler pieces.* %	*Ch*
Austria	...	98	...	
Belgium	60	40	...	
Denmark	40	60	...	
South Funen	...	100	...	
Finland	...	100	...	
France :				
S.N.C.F. — Est	85	15	...	
Nord	99	1	...	
Ouest	59	1	...	
Sud-Ouest	46	...	...	
Sud-Est	80	20	...	
Somain-Anzin	100	...	...	
Sté Gle des Ch. de fer Economiques	81	8	...	
Ch. de fer Economiques du Nord	...	100	...	
Ch. de fer Vicinaux	100	...	...	
Métropolitain de Paris	15	76	...	
Indo-China Railway	100	...	...	
Tunisia	100	...	...	
Holland	...	24	34	
Italy : State Railways	70	30	...	
Norway	...	100	...	
Poland	...	100	...	
Portugal	100	...	...	
Swedish State	80	20	...	
Switzerland :				
Federal Railways	...	100	...	
Rhaetian Railways	...	100	...	

SLEEPERS.

on certain railways.

g by coachscrews.		*Fixing by spikes.*				*Remarks.*
Length of coach-screws.	*Hole in sleeper.* $\overline{\Phi}$	*Section.*	*Length.*	*Hole.* $\overline{\Phi}$	*Depth of hole.*	
150	24	18 × 18	160	18	...	Hard wood.
	20	...	...	15	...	Soft wood.
130	17	...	...	...	...	Hard wood.
	14	...	...	...	...	Soft wood.
150	16	...	...	...	...	Beech. } rails 60 kgr./m.
	13.5	...	...	...	...	Deal. }
150	18	...	...	...	...	Beech. } rails 45 kgr./m.
	15.5	...	...	...	...	Deal. }
150	12	16 × 16	150	...	...	Soft wood sleepers.
...	...	—d°—	170	...	...	Ordinary spikes.
			210	...	...	Track exposed to frost.
120	16-17	...	...	...	...	Hard wood. } (1) Standardised
140	15-16	...	...	...	...	Deal. } types of coach-
						screws used on
120	17.5-18.5	...	...	...	...	Hard wood. } the lines of the
140	16.5-17.5	..	...	...	...	Deal. } S.N.C.F.
151	25	...	...	...	...	Hard wood.
	18	...	...	...	...	Soft wood.
120	26	...	...	...	...	Hard wood.
	24	...	...	...	...	Soft wood.
120	14					
105	14					
120	18.5	...	...	...	...	Suburban system.
120	17	...	...	...	...	Urban system.
141	18					
151	19					
190	16	...	...	...	...	Hard wood. } chairs.
	13	...	...	...	...	Soft wood. }
160	16	...	...	...	...	Filler pieces — hard wood.
		15 × 18	180	13	60	
		14 × 16	145	12	60	
140	20	...	...	...	...	Oak.
	18	...	...	...	...	Beech.
	16	16 × 14	150	...	...	Deal.
...	...	...	...	...	...	70 % spikes.
						30 % coachscrews.
150						
146	16					
150	15	12 × 16	165			
178	18	20 × 20	185	18		
...	...	14 × 14	150	...	...	Spikes only.

Many railways were obliged to give up renewing the ballast during the war almost entirely, and the resulting damage to the sleepers in the present period of shortage of wood is very serious.

10. *Insulation of track laid on wood sleepers.*

Sleepers impregnated with creosote are sufficiently insulated to enable track circuit equipment to be used without special insulating devices, the use of which is not reported by any railway.

The French National Railways, however, have found that if the ends of the coachscrews come into contact with the ballast through the sleepers, the resistivity of the track is decreased, especially in wet weather, or in the case of certain types of ballast with poor insulating qualities such as freshly produced slag. This is the reason why shorter coachscrews are used, as reported above, so that the hole will not extend right through the sleeper. This precaution also keeps the fastenings tight, as it has been found that when the sleepers are too thin and the coachscrews touch the ballast, the fastenings soon get loose.

11. *Causes of deterioration of sleepers.*

The answers received from the different railways show that there are three causes :

1) cracks and splitting;

2) mechanical wear near the rail;

3) rot.

Cracks and splitting.

These are bad not only because they spoil the mechanical resistance of sleepers, but because :

a) they nearly always occur near the coachscrew holes and the steps taken to improve the fastening nearly always facilitate their development;

b) they let air, water and earth into the wood, which encourages; rot in the middle of the sleeper.

The preventive measures already described are effective, especially putting holding bands round the sleepers, which has the advantage of being a remedy that can be applied to sleepers already split on the track, without however completely overcoming the drawbacks mentioned above. It is therefore better to prevent splits forming in the first place, which is the reason why the French National Railways propose to apply such bands to all sleepers systematically when they are being made.

Oak is particularly liable to split, whereas deal does not, though oak is much the more lasting, so that the systematic hooping of oak sleepers will give excellent results.

Mechanical wear.

This shows itself in different ways :

a) wear of the bearing surface (and sometimes of its shoulder faces).

This is due first of all to the crushing of the wood under the constant rolling loads and is accentuated by the hammer blows due to imperfect tightening up of the fastenings; it is also due, but to a lesser extent, to the foot of the rail cutting into the fibres during the transmission of longitudinal stresses (expansion and creep), and lateral stresses (hunting, running round curves), generally distributed over the surface.

This wear will lead to the rail sinking into the sleeper, often unevenly, and ends by making it necessary to recut the surfaces or shoulder faces which reduces the useful thickness of the sleeper under the rail, repetition of which leads to the sleeper being regraded.

b) wear of the fastening holes.

The fastenings are not only pulled out vertically by the alternating stresses of the rolling loads and transverse stresses transmitted by the rail, which tend to bend the fastenings and make the

holes oval, but also to short period vibrations due to irregularities in the rail surface or wheel tyres and defects in level, such vibrations increasing the destructive force pulling at the fastenings.

This leads first of all to loosening of the fastenings which in turn leads to wear of the bearing surface, which turns these stresses into violent shocks; the process of reciprocal destruction increases very rapidly, until maintenance work has to be undertaken; repair of the bearing surfaces and shoulder faces and consolidation of the fastenings, which operations take place at the expense of the actual body of the sleeper.

We will see further on that certain maintenance methods and ways of repairing fastenings have a tendency to lead to the formation of splits and cracks.

The wear of the underside of the sleeper owing to the ballast cutting into it does not appear to have any great effect on its life. This wear is not extensive. Methods of maintenance however in which tamping is used, if no precautions are taken, lead to a rapid destruction of the lower edges, increase the incrustation of the ballast and reduce the useful bearing surface of the sleeper on the ballast.

Rot.

The combined action of atmospheric factors, humidity of the soil, fungi, etc., lead to rot, the natural decay of the wood in the sleepers. This decay is a function of the time and not the traffic, but the speed at which it takes place depends on the quality of the wood, local atmospheric conditions, and even the position of the track, the nature of the soil and the cleanness of the ballast.

The methods of treating wood described above delay the effects of rot to a considerable extent for certain kinds of wood. Beech which has not been treated will only last a few years; if carefully impregnated with creosote its life compares with that of oak, i.e. several dozen years.

This explains the importance of the products used and methods practised. With certain kinds of wood which are very liable to rot, such as beech, an inappropriate method of impregnation will lead to deceptive results; for example certain sleepers which have not been impregnated all through will rot rapidly at the centre and become hollow, though the outside is well preserved. Such processes as the « double Ruping » for example were perfected to prevent such premature decay of hardwood sleepers.

Finally, though this was not mentioned by most of the railways, mention must be made of the destruction of sleepers owing to fires on the permanent way, caused by cinders from steam locomotives, which obviously will not occur in the case of electrified lines.

Sleepers freshly impregnated with creosote catch fire very easily, as well as sleepers that have split in the middle or become hollow.

Such destruction of sleepers by fire is very serious, as it usually destroys sleepers in a good state of repair on main lines. The risk which amounts to 1/1 000 a year on certain lines on gradients, can be reduced by a heavier covering of ballast, and above all by fitting the engines with better ash-pans. We know that certain railways have got very good results by doing this. Unfortunately, we had not enough time to extend our enquiry in this direction.

At certain special points, such as lines in sheds and where locomotives are shunted or stand, it may be necessary to prevent this risk by giving up using wood sleepers, replacing them by metal or reinforced concrete ones.

To sum up, apart from splitting and destruction by fire, the sleepers are affected by two destructive forces :

— rot, which for a given kind of wood, treatment and conditions is merely a function of the time;

— mechanical wear, which is a function of the traffic, the quality of the maintenance work, and the method of fastening the rail to the sleepers.

The economic solution to be sought by a careful selection of the kind of wood, the quality and treatment of the wood and appropriate methods of fastening and maintenance would appear to be that which, for a line with a given traffic, corresponds to simultaneous decay of the sleeper through mechanical wear and the ageing of the wood.

For example, in order to get the best possible use from wood sleepers impregnated with creosote on heavily loaded lines, where mechanical wear is generally the predominating factor, it seems advisable to reduce the latter as much as possible by using bearing plates and suitable fastenings.

Soft woods need only be protected summarily against rot, as whatever method of fastening is used, mechanical wear will predominate : this is really the reason why the Swedish Railways systematically treat only a small proportion of their deal sleepers.

On the other hand, it is necessary to treat soft wood sleepers on lines where bull-headed rails are used, as mechanical wear is much less in this case, especially when larged based chairs are used.

Finally, on secondary lines with light traffic, where there is very little mechanical wear, it is usually advisable to use sleepers that have been carefully impregnated to prevent them rotting.

12. *Classification and utilisation of sleepers taken out of main lines.*

Whatever method of fastening is used and however carefully these are maintained, sleepers on lines carrying heavy traffic usually have to be replaced before the wood has rotted, either because successive reconditioning of the bearing surfaces has made the sleepers insufficiently resistive to loads owing to the reduced thickness under the rails, or because it is no longer possible to tighten up the fastenings securely.

When being replaced the sleepers are classified in order to determine the best use to which they can be put.

This classification usually depends on the minimum thickness of wood under the bearing surface. Thus :

The Austrian Railways classify old sleepers into 4 grades : those at least 15 cm. ($5^{23}/_{32}''$) thick can be re-used on lines in Categories I and II, those between 15 and 12 cm. ($5^{23}/_{32}''$ and $4^{23}/_{32}''$) thick on Category III lines; those between 12 and 10 cm. ($4^{23}/_{32}''$ and $3^{15}/_{16}''$) thick on sidings; whilst the others are classed as throw-outs and used for various other purposes.

The Belgian Railways have a similar classification with 5 grades :

1. — if the thickness is at least equal to 11 cm. ($4^{11}/_{32}''$) for re-use in maintaining category I and II lines;

2. — if the thickness lies between 11 and 10 cm. ($4^{11}/_{32}''$ and $3^{15}/_{16}''$) for re-use on category III and IV lines;

3. — if the thickness is between 10 and 8 cm. ($3^{15}/_{16}''$ and $3^{5}/_{32}''$) for re-use on sidings (category IV);

4. — if between 8 and 7 cm. ($3^{5}/_{32}''$ and $2^{3}/_{4}''$) thick on certain branch lines or works sidings;

5. — if less than 7 cm. ($2^{3}/_{4}''$) thick, classed as throw-outs.

Most of the Railways use a similar classification, though often a less detailed one.

The system used on the French National Railways is based on the same principles, but also takes into account the fact that repair of the sleepers if necessary takes place in special shops where the sleepers are usually mechanically refaced on the bearing surfaces, then classified and sent out again.

The classification used by the French National Railways is as follows :

V.P.a (1) *Sleepers* which can be re-used in the present condition on main lines in categories II or III, or on heavily trafficked station lines; such sleepers must be at least 10 cm. thick, with bearing surface in good condition, at least 2.40 m. (7'10½") long. without any dangerous splits.

V.P.b. Sleepers, as above, but on which the bearing surfaces have to be renewed by adzing in the shops, after which they must be at least 10 cm. thick.

V.G.a (1) *Sleepers,* which can be re-used as they are in sidings; the bearing surface must be in a good state of repair with no serious defects in the wood, at least 2.20 m. (7'2⁵/₈") long and 8 cm. thick.

V.G.b Sleepers, like the previous grade, but requiring to be adzed in the shops, after which they must be at least 8 cm. thick.

Other sleepers are classified as throw-outs.

Use made of throw-outs.

Though some railways, particularly the Swedish Railways, merely use these as firewood, which is justified by the natural resources of this heavily wooded country and the fact that their steam locomotives are wood-fired, on most railways they are only burnt (either by the railway itself to light the boilers or sold for private use) when they cannot be used for any other purpose.

Amongst such purposes mention may be made of :

a) making station and level-crossing gates and barriers, enclosures for coal dumps, edges to platforms, flooring for level crossings, trestles for mounting equipment on; these different examples being mentioned by Denmark, the Swiss Federal Railways, Holland, French National Railways and secondary French Railways in particular;

b) the best parts of the wood being used for carpentry (Denmark) making ties and keys (French National Railways, French secondary Railways, Algeria, Tunisia) and for making trenails to mend the fastenings (French National Railways);

c) making charcoal for producer-gas plant, especially during and since the war, reported by Belgium and France.

The French National Railways grade throw-out sleepers into three groups, the grading usually being made in shops to which the sleepers are sent :

R.A. Sleepers which can at a pinch be used on engineer's lines on earthworks or in ballast pits;

R.B. Sleepers out of which ties, keys and trenails can be made (1);

R.C. Sleepers which can only be used for burning and are usually sold cheap to employees.

CHAPTER III.

Metal sleepers.

Certain countries, which are large exporters of steel, such as Luxemburg and Germany, and other countries having close economic relations with them, developed the use of metal sleepers, especially before the 1914 war.

In addition, railways in the Colonies where wood sleepers cannot stand up to attacks by termites, have laid all the permanent way on metal sleepers (Togoland, Belgian Congo).

(1) V.P. and V.G. stand for running lines and sidings respectively.

(1) The progress made in the use of producer-gas, immediately before and above all during the war, has led to a valuable new outlet for the second grade of throw-out sleepers (R.B.).

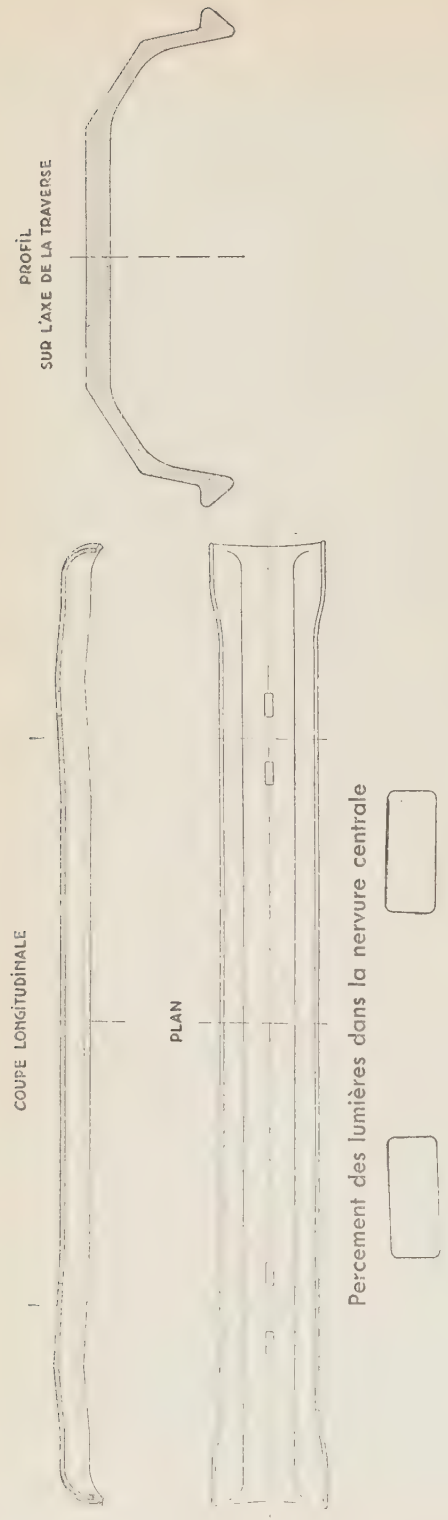


Fig. 12. — Metal sleeper.
Explanation of French terms :
Percement des lumières dans la nervure centrale = forming of slots in central web. — Coupe longitudinale = longitudinal section. — Profil sur l'axe de la traverse = view on centre line of sleeper.

Certain railways, such as the Swiss Railways, have decided that metal sleepers have such an advantage over wood sleepers that their use should be extended to a large proportion of the permanent way in spite of their higher cost price; other railways on the contrary who have been obliged to use metal sleepers at certain periods on account of a shortage of wood, particularly after the first world war, have not extended their use, or have only used them in certain special cases.

Finally certain countries, such as the Scandinavian countries, have so far never used metal sleepers.

1. *Shape and size of metal sleepers.*

Various types of metal sleepers are used by the railways, but the only difference lies in details, the method of supporting and fastening the rail, and to a small extent the size.

They are always (Fig. 12) trough shaped, made of mild steel rolled sections, die stamped hot to form the curved outer splayed ends and certain details of the shape, such as reduction in width of the central part or inclination of 1/20th. of the upper surface as required. The holes are usually made by punching when hot.

The useful length of sleepers for standard gauge lines varies generally between 2.70 m. (8′10¼″) (Luxemburg type 17) and 2.40 m. (7′10½″) (Damas-Hama Railway type Rayak-Alep), the tendency being to shorten them, the older types of sleepers being usually about 2.70 m. and the more recent ones 2.55 or 2.50 m. (8′4⁷/₁₆″ or 8′2⁷/₁₀″). (This is so for example on the Swiss Federal Railways, the French National Railways, and in Czechoslovakia.)

The section adopted has a flat part on the upper portion corresponding to the bearing surface of wood sleepers, the width of which is on the average 120 to 140 mm. (4²³/₃₂″ to 5½″) (exceptionally

190 mm. [7½″] on recent types used in Czechoslovakia). The side faces are vertical or slightly flared out at the bottom, and strengthened by a flange on the underside in contact with the ballast. The translation between this and the flat upper surface is usually rounded, or formed of two faces at an angle.

The thickness of the steel sheet forming the sleeper is usually greater on the upper part than on the sides, and varies is sometimes increased in order to increase the modulus of inertia in the centre of the track; this additional height is obtained at the expense of the width by stamping the sleepers when hot. This method of reinforcement is adopted by the Rhaetian Railways and the Alep Railways (Fig. 13). This special shape does not appear to be of great interest.

The weight of metal sleepers for stand-

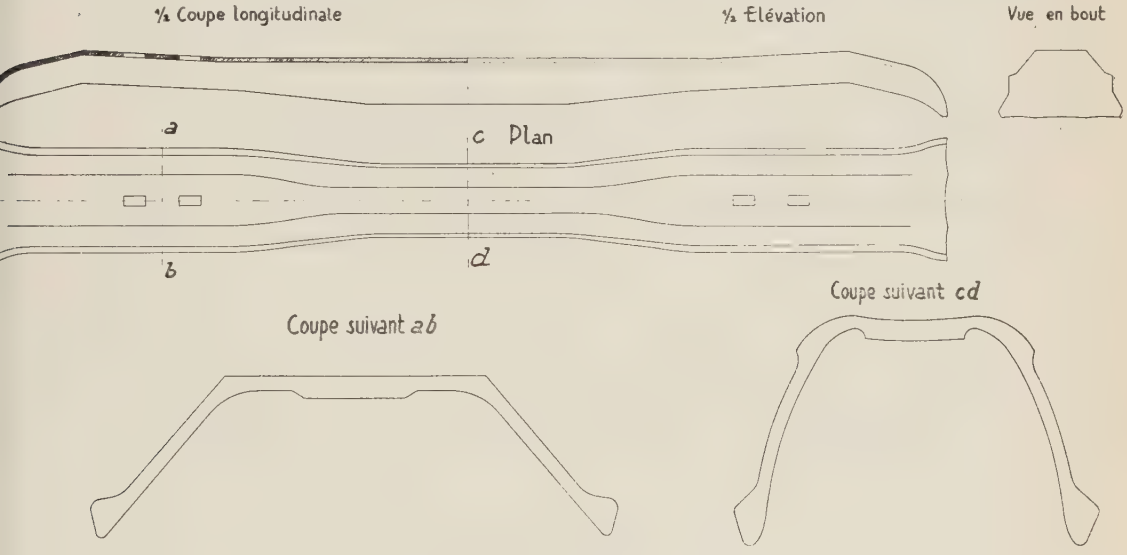


Fig. 13. — Metal sleeper with narrow centre portion.

Explanation of French terms :
Coupe longitudinale = longitudinal section. — Vue en bout = end view. — Coupe suivant = section through.

from 11 to 13 mm. ($^{7}/_{16}$″ to $^{33}/_{64}$″) in the case of the former and 7 to 9 mm. ($^{9}/_{32}$″ to $^{23}/_{64}$″) in the case of the latter. The Austrian Railways, however, and the Belgian National Railways have adopted a uniform thickness of 9 and 8 mm. ($^{23}/_{64}$″ and $^{5}/_{16}$″) respectively.

The width of the base varies from 230 to 270 mm. ($9^{1}/_{16}$″ to $10^{5}/_{8}$″), and the height from 75 to 95 mm. ($2^{61}/_{64}$″ to $3^{47}/_{64}$″). The height of the sleepers at the middle

ard gauge track varies between 50 and 75 kgr. (110 lbs. and 165 lbs.), being very similar to that of wood sleepers. However, the Czechoslovakian Railways have recently put metal sleepers into service weighing 85 kgr. (187 lbs.), which are therefore definitely heavier than any so far used on other railways.

The sleepers used on narrow gauge lines (1 m. = 3′3$^{3}/_{8}$″) vary in length between 1.80 and 2 m. (5′10$^{7}/_{8}$″ and 6′6$^{3}/_{4}$″)

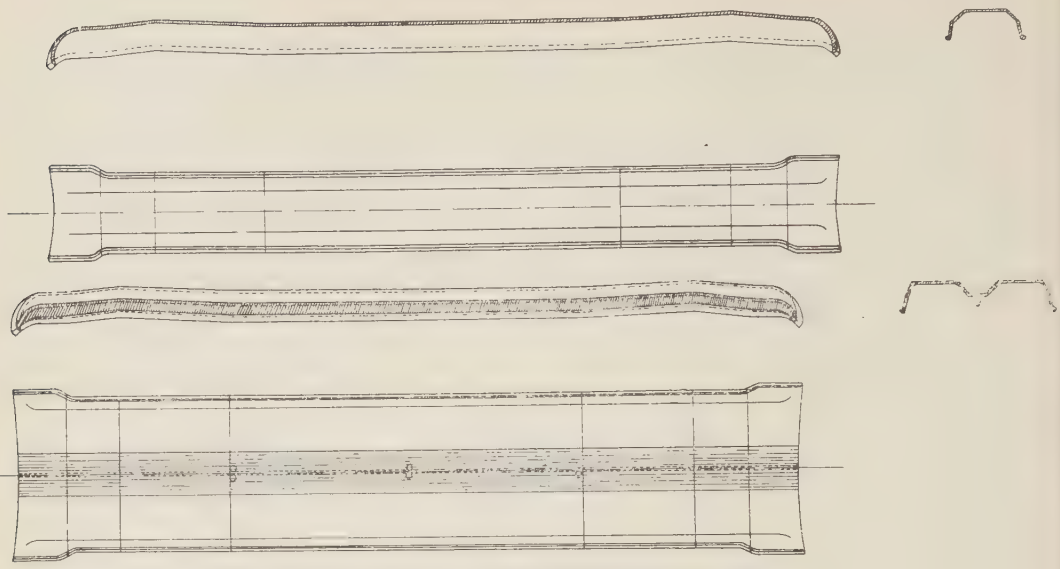


Fig. 14. Double metal sleeper for use at rail joints.

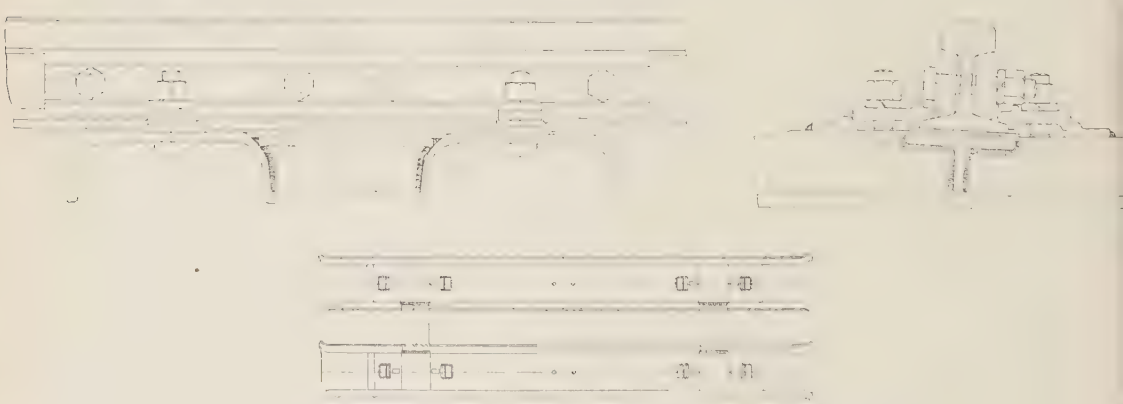


Fig. 15. — Double metal sleeper for use at rail joints. — Czechoslovakian type.

and usually weigh about 37 kgr. (81 lbs.).

Certain railways (Austria, Belgium, Algeria, Swiss Federal and Rhaetian Railways) have profited by the facilities given by rolling and stamping to make double sleepers for joints (Fig. 14). These have the same section as two sleepers joined together, but are generally strengthened (thicker, wider top surfaces, sometimes greater height), and are sometimes longer (for example the double German K49 type used by the Austrian Railways and those used on the metric gauge lines of the Rhaetian Railways).

Mention must also be made of the particular arrangement adopted by the Czechoslovakian Railways for sleepers at joints (Fig 15) : two sleepers of the

running lines (of the most recent T2 or A type) are joined together by two T irons placed under each rail and welded to the flanges of each sleeper.

Table VII gives the dimensions and chief characteristics of the most usual types of metal sleepers on a certain number of railways.

2. *Supporting and fastening the rails on metal sleepers.*

Whereas the general shape of the metal sleepers used does not vary much from one railway to another, the methods used on the different railways for fastening the rails are very diverse. They may however be classified into the following categories similar to those found in the case of fastenings for wood sleepers :

— laid on chairs (bull-headed rails);

— directly fastened to the sleepers, the top surface of which is die stamped, inclined at 1 in 20.

— laid on bearing plates, inclined at 1 in 20 or flat, with direct fastenings;

— laid on bearing plates with indirect fastenings.

a) *Laid on chairs.*

This old method, still to be found on certain lines of the Austrian Railways and the French National Railways in the case of 27 % of their metal sleepered track, has now been given up, together with the bull-headed rail itself. Moreover, there is not the same interest with metal sleepers in distributing the load over a great surface that there is with wood sleepers, and this method has the drawback that it involves steel coming into contact with steel in two places.

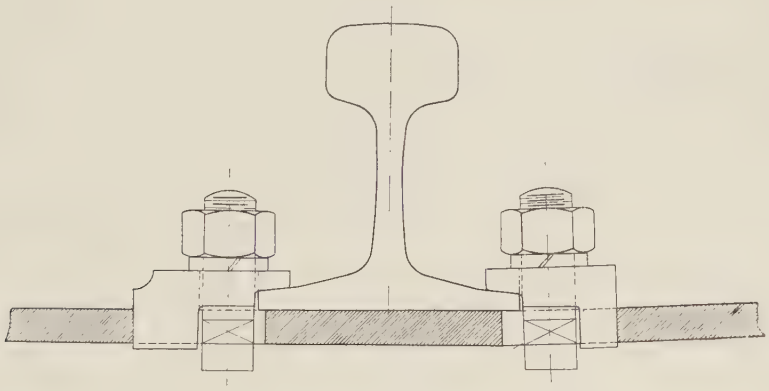


Fig. 16. — Rail fastened directly to metal sleeper.

The chairs are fastened by bolts through the sleepers, with or without the use of sleeper clips.

b) *Laid direct on the sleepers.*

This is the most simple method (Fig. 16).

It is the method usually employed by the French National Railways and the Algerian, Tunisian, and Indochinese Railways, as well as the Italian State Railways, the Swiss Federal Railways and the Rhaetian Railways. The Austrian Railways on the other hand have given it up in favour of a more complicated method.

T

CHARACTERISTICS OF CUR

Railway.	*Type.*	*Total length. mm.*	*Working surface. mm.*	*Width at base. mm.*	*Heig of si mm*
Austria	Normal.	2 500	135	260	10
	Double at joint.	2 600	2 × 135	490	10
Belgium :					
S.N.C.B.	Normal.	2 550	135	266	10
	Double at joint.	2 550	2 × 145	510	10
Matadi-Léopoldville (V.E.)	...	2 024	120	232	7
Lower Congo-Katanga (V.E.)	...	2 000	140	220	7
France :					
S.N.C.F.	Normal standard.	2 550	140	266	8
Algeria	Normal.	2 550	140	266	8
	Joint.	2 550	327	432	8
Damas-Hama	Rayak Alep.	2 400	130	261	8
Tunisia	Normal standard.	2 550	140	266	8
Togo (V.E.)	Standard 26 kgr.	1 900	120	230	7
(V.E.)	Haarmann	1 900	115	203	7
Italy :					
Italian State Railways	...	2 500	116	207	9
Luxemburg	Type 17.	2 700	120	232	7
	Ougrée-Marihaye.	2 550	140	263	3
Poland	...	2 600	120	232	7
Switzerland :					
Swiss Federal Railways	Normal	2 550	130	240	9
	Double at joint.	2 550	2 × 135	432	9
Rhaetian (V.E.)	Normal.	1 800	120	230	7
	Double at joint.	1 900	2 × 135	500	7
Czechoslovakia	T.	2 500	150	250	8
	T_2	2 500	190	270	9

Note : V.E. = Narrow gauge.

OF METAL SLEEPERS.

ness ring ce.	Thickness of side. mm.	Bearing surface: horizontal = H. sloped 1 in 20 = 1	Centre portion reduced in size = P	Weight of sleeper. kgr.	Type of rail fastening.	
	9	1	...	84.85	S.I.	S.I. = Indirect bearing plate.
	9	1	...	145.8	S.I.	D. = direct.
	8	1	...	69.750	S.I.	S.D. = Direct bearing plate.
	8	1	...	132.500	S.I.	O. = Ougrée-Marihaye.
	...	1	...	46.4	D.	T. = Direct Czechoslovakian.
	7	1	...	46.4	D.	
	7	1	...	75.3	D.	
	7	1	...	75.3	D.	
	7	1	...	118	D.	
	6.5	1	P	50	D.	
	7	1	...	75.3	D.	
	8	1	P	44.730	D.	
5	7.5	H	...	30	S.D.	
	7	1	...	68.5	D.	
	9	H	...	58.3	S.D.	
	...	1	...	66	O.	
	7	1	...	60	S.I.	
	7	1	...	68	D.	
	7	1	...	116	D.	
5	8.5	1	P	37	D.	
	9	1	P	98	D.	
	8	1	...	81	T.	
	8	1	...	85	T.	

The rails rest on bearing surfaces inclined at 1 in 20 and formed during the stamping process, either directly or through bearing plates to prevent steel coming into contact with steel. The fastening consists of hook bolts or flatheaded bolts and steel sleeper clips with Grover washers between the nut and clip.

To keep the clips in place laterally and in addition make it possible to insert the bolts from the top, the holes made in the sleepers are generally rectangular slots with rounded corners to prevent cracks starting there. The Swiss Federal Railways report that they have given up using slots with sharp angles and adopted rounded corners of 3 mm. ($^1/_8$″) radius opposite the rail and 5 mm. ($^{13}/_{64}$″) radius against the rail. The width of the slots is slightly larger than the diameter of the bolts and varies from 21 mm. ($^{53}/_{64}$″) on metre gauge lines (Matadi-Leopoldville) to 23 mm. ($^{29}/_{32}$″) (Swiss Federal Railways) and 26 mm. ($1^1/_{32}$″) (French National Railways); the length of the slots varies on these same railways from 49 mm. to 56 and 65 mm. ($1^{15}/_{16}$″ to $2^{13}/_{64}$″ and $2^9/_{16}$″).

The clips usually have a claw which is inserted into the slots and by pressing against their edges assures that the rail is held in position laterally. The different gauges of track are obtained by using clips with different sized claws. The play of the clips also makes it possible to use rails with different sizes of flanges on the same sleepers.

The diameter of the bolts used varies according to the method of laying adopted and from railway to railway, between 19 and 24 mm. ($^3/_4$″ and $^{15}/_{16}$″), but they are usually 22 or 24 mm. ($^7/_8$″ or $^{15}/_{16}$″).

The bearing plates sometimes used to protect the bearing surfaces of the sleeper and rails against reciprocal wear and give greater elasticity and less noise when wheels run over them, are made of bakelised or impregnated wood, or rubber; the Italian State Railways,

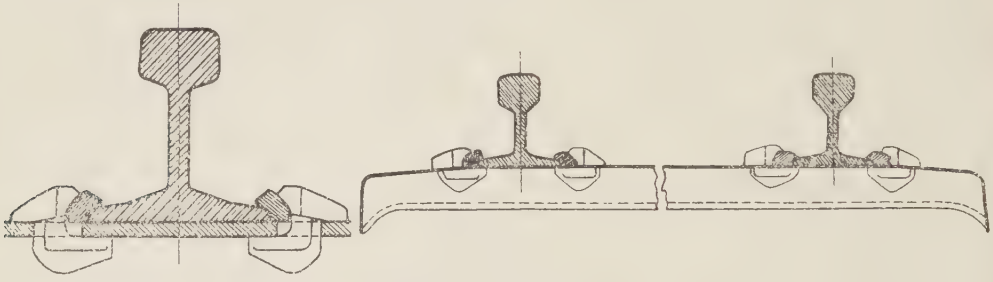


Fig. 17. — Rail fastened directly to metal sleeper. Ougrée-Marihaye type.

the Swiss Federal Railways, Poland, Austria anhd Czechoslovakia use bearing plates made of poplar impregnated and compressed 4 to 6 mm. ($^5/_{32}$″ to $^{15}/_{64}$″) thick. Czechoslovakia however reports that these split and chip. The French National Railways, Swiss Federal Railways and Algerian Railways have used bearing plates made of bakelised or impregnated wood, but prefer them made entirely of rubber. These rubber bearing plates, 3 to 6 mm. ($^1/_8$″ to $^{15}/_{64}$″) thick, are always used on curves by the Swiss Federal Railways (who prefer to use metal rather than wood sleepers on curves) and at joints by the Tunisian Railways who have found them satisfactory.

Certain railways do not use bearing plates with direct fastenings; this is the

case in particular on the Belgian and Luxemburg Railways. The French National Railways do not in principle use bearing plates, but there are still some old sections of line laid on bearing plates which appear to be satisfactory. This policy of not using bearing plates is due to the fact that it is harder to keep the fastenings tight when slightly elastic bearing plates are used, as the

which the rails are fastened not by bolts but by hooks which fit into the slots in the sleepers and hold the rail flange tight by means of a long key-shaped cotter pin (Fig. 17);

— the Czechoslovakian Railways use a method of fastening, in which the sleeper clip holds the rail instead of being merely fitted into a slot, including a shoulder piece which bears against a

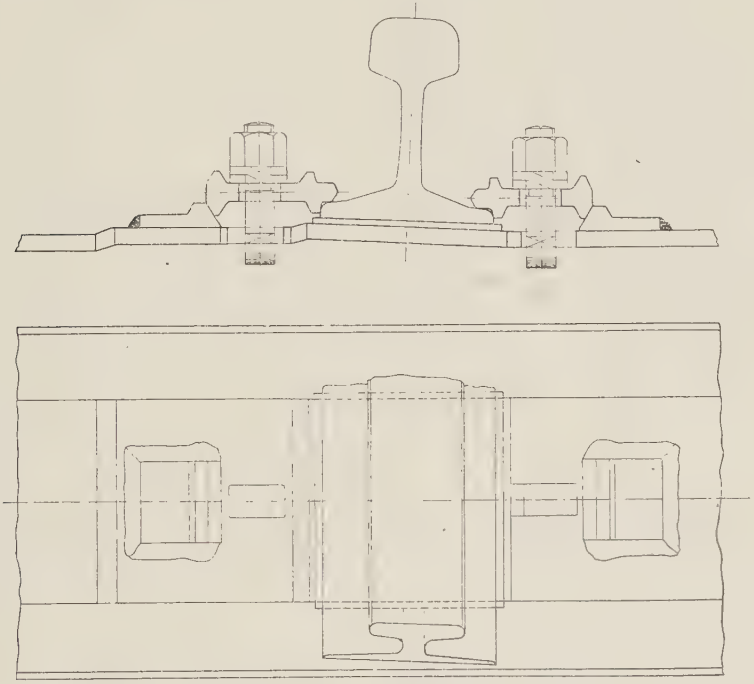


Fig. 18. — Rail fastened directly to metal sleeper. Czechoslovakian type.

Algerian Railways report. We will return to this point when dealing with concrete sleepers.

Two Railways have described a slightly different system of direct fastening:

— the Luxemburg Railways — (who now appear to be giving up extensive use of metal sleepers) and the Belgian National Railways still have some sleepers of the Ougrée-Marihaye type on

plate welded on to the sleeper. The clips are reversible and of two types, a combination of which makes it possible to obtain differences in gauge varying by 4 mm. ($^5/_{32}''$) from 0 to 28 mm. (0 to $1^7/_{64}''$). This plate, like the clips, has an inclined surface which makes it possible by tightening up two bolts on each side of the rail together to regulate the gauge very accurately and obtain great lateral tightness of the flange. This

arrangement is similar to that adopted by this railways in the case of wood sleepers described above, and makes it possible to reduce the length of the slots to 42 and 46 mm. ($1^{21}/_{32}''$ and $1^{13}/_{16}''$) according to type (Fig. 18).

It would be interesting to know if this method, which is somewhat more complicated than a simple fastening by means of a sleeper clip with a claw since it involves welding 4 plates on each sleeper, is justified in practice by any saving in maintenance or better behaviour of the track laid in this way as regards the maintenance of the alignment and gauge and resistance to creep.

c) *Laid on metal bearing plates with direct fastenings.*

This method is used with the Haarmann sleepers (Fig. 19) used by the Turkish, Togo, Syrian Railways, and formerly by the Luxemburg Railways, who have now given it up.

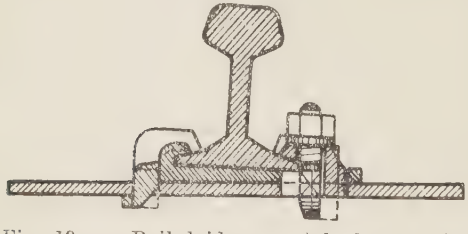


Fig. 19. — Rail laid on metal sleeper with direct fastenings of the Haarmann type.

It consists of a webbed bearing plate fixed to the sleeper on the side outside the track by means of a claw fitting into a rectangular slot made in the sleeper and on the inside of the track by a flat-headed bolt which holds the rail at the same time by means of a clip, as in the simple method without a bearing plate. The rolled steel bearing plate provides the inclination of 1 in 20 and the bearing surfaces of the sleeper itself are flat. Differences of gauge on curves are obtained by different combinations of bearing plates and clips; 3 types of

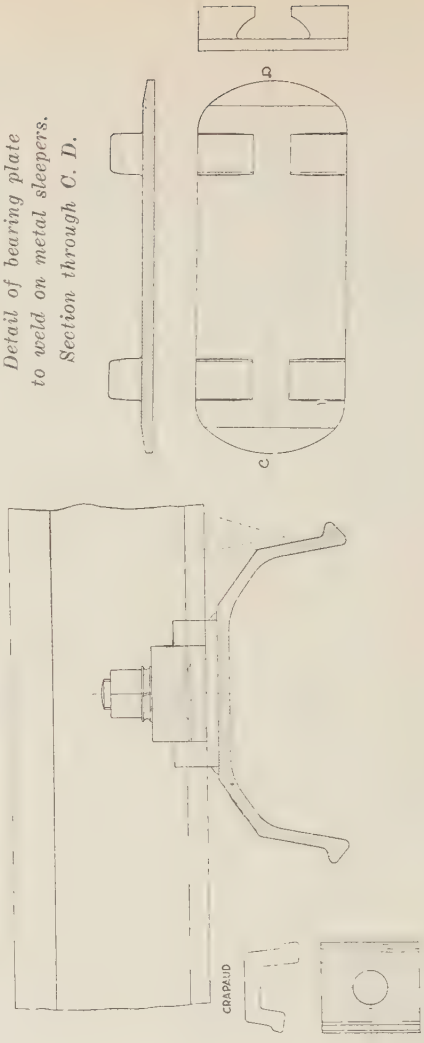


Fig. 20. — Rail laid on metal sleeper with indirect fastenings of the K. 49 type.
Explanation of French terms :
Crapaud = sleeper clip.

bearing plates and 3 types of clips are used.

This arrangement has the drawback of steel coming into contact with steel twice instead of once, which leads to wear of the rail-bearing plate assembly and claw-sleeper assembly between the track, soon gives rise to play, and spreads out the gauge, as the single bolt is not sufficient to prevent this.

It does not seem as though these drawbacks were compensated by the slight simplification of making flat sleepers without inclined bearing surfaces.

d) *Laid on metal bearing plates with indirect fastenings.*

This method is similar to the German K49 type already described in the case of wood sleepers, but the bearing plate is welded to the metal sleeper, and the rail is fastened by means of clips and bolts in the same way (Fig. 20), differences of gauge on curves being obtained in the factory by welding the bearing plates to the sleepers in the desired position.

The Belgian and Polish Railways use this type of fastening, as well as the Austrian Railways in recent cases. The latter insert a 5 mm. ($^{13}/_{64}$") wooden filler piece between rail and bearing plate.

3. *Effects of the ballast on metal sleepers.*

Certain railways using slag for ballast, such as Czechoslovakia, Luxemburg, the Belgian Railways and French National Railways, have found that this has a corrosive action. In Belgium, however, this has not been found serious except when granulated slag is used, and the Czechoslovakian Railways think it only occurs with fresh slag.

The Nord area of the French National Railways where the greater part of the permanent way is ballasted with broken slag (20/70), though they have found that fresh slag has a corrosive effect due to the presence of sulphur in the first few months after the ballast is laid, have not given up using metal sleepers on this account.

A recent examination of sleepers laid more than 25 years ago on slag ballast did not reveal any greater corrosion than in the case of those laid on crushed stone ballast. On the other hand, this examination showed that the mechanical wear of the lower surface of the sleeper due to the action of the slag was greater than in the case of crushed stone, owing to its abrasive action and the fact that it is not polished by wear. This mechanical wear is however not such as to cause any appreciable diminution in the life of metal sleepers.

On the other hand cinders, usually from the locomotive sheds, have a markedly corrosive action on metal sleepers, but this does not prevent metal sleepers being used in certain sidings in the sheds or places where the locomotives stand, as wood sleepers are much more perishable in this case owing to the fires which occur.

4. *Electric insulation of metal sleepers.*

The most serious drawback to metal sleepers is the fact that they cannot be used on lines equipped with track circuits unless special arrangements are made to insulate them. The development of light signals for automatic signalling and various interlocking devices involving the use of track circuits are assuming an ever greater importance.

The Swiss Federal Railways are the only Administration to report trials of metal sleepers on track equipped with track circuits, these being justified by the large proportion (about 2/3rds.) of metal sleepers on this Railway.

The insulating device consists of bakelite plates or plates of some similar insultating fibre, inserted between the foot of the rail and the sleeper on the

one hand and between the sleeper clips and the foot of the rail on the other hand. The trials are still being carried out, and so far have not been entirely satisfactory.

5. *Wear, repair and reclassification of metal sleepers.*

Metal sleepers usually last longer than wood sleepers. Their natural decay through rust which gradually reduces the thickness of the sleeper, especially the under parts, does not usually occur till they have been in use for some 50 years, except in circumstances particularly favourable to oxydisation, such as near the sea. When the sleepers are badly attacked by rust, they cannot be repaired or used any more. But, before their strength has been seriously impaired by rust, they have usually become unsuitable for use on main lines, especially lines in Category I, on account of wear of the bearing surfaces or cracks around the fastenings, and the lack of accuracy and ineffectiveness of the fastenings, due to play caused by wear. Such sleepers are reclassified and used again on lines with slow light traffic, and lines in Category IV, after the necessary repairs have been carried out.

The fastenings themselves are not repaired, but if needs be replaced by new ones (bolts, clips), and wear of the slots is made good using small steel wedges fastened to the claws of the clips (Hattingen sleeves used by the Swiss Federal Railways).

The repairs carried out to metal sleepers are of two kinds:

a) repair of cracks, which usually occur at the corners of the slots, even if these are rounded. They are repaired by welding on most railways, the cracked parts sometimes being reinforced by a sleeve (Poland, Switzerland, Czechoslovakia). The possibilities of welding are so great that it is even possible to rebuild a metal sleeper from the sound parts of several worn sleepers (Austria).

b) repair of worn bearing surfaces which the rail foot has ended by wearing into, which is easily done by means of welding on a piece of plate which usually extends beyond the slots and thereby reinforces them (Austria, Switzerland, Czechoslovakia).

Sleepers repaired in this way are used again on lines in Categories III or IV, as well as worn sleepers which do not require repair. The Swiss Federal Railways report in this connection that 80 to 90 % of the sleepers replaced on lines in Category I can be re-used although their average age is over 45 years.

Sleepers withdrawn from service are generally of little value and are scrapped. The best ones, however, are sometimes used to make aprons or protecting walls to hold up banks, or as a protection against falls of snow or stones on the Swiss Federal Railways, the construction of platforms on secondary lines (French National Railways), etc.; mention may also be made of their use in Syria as a base for telegraph posts.

CHAPTER IV.

Reinforced concrete transverse and longitudinal sleepers.

1. *General.*

The shortage of wood after the first world war resulted in trials being made of reinforced concrete on the permanent way together with some extension of the use of metal sleepers. Many types of reinforced concrete sleepers were designed in countries seriously affected by the war, whose natural timber resources had become insufficient, such as France and her Colonies, Belgium, Italy, and even Switzerland. These trials, often on a large scale, were as a rule somewhat misleading. They took place long enough ago for the selection of the rare types, which have stood up in service, to be both easy to effect and worth relying on.

In the following report we will deal only with those of the old types whose value has been confirmed by time. The last war has resulted in many countries finding themselves in the same situation as after the 1914 war, and to make matters worse, the extreme shortage of wood has coincided with exceptionally widespread destruction and a coal crisis such as has never before been known, and in a consequence a steel crisis.

Many countries therefore in view of their former experiences have once more turned to the problem of laying the track on reinforced concrete, a material which does not involve the use of much coal in the manufacture of the necessary cement and steel.

Unfortunately, we did not receive many details concerning the types which the railways are making, nor on the practical results obtained, which of course cannot be considered as final in view of the short time involved.

We think this chapter is of interest however; we have endeavoured not only to report the results of former experiences but to show the direction being followed at the present time.

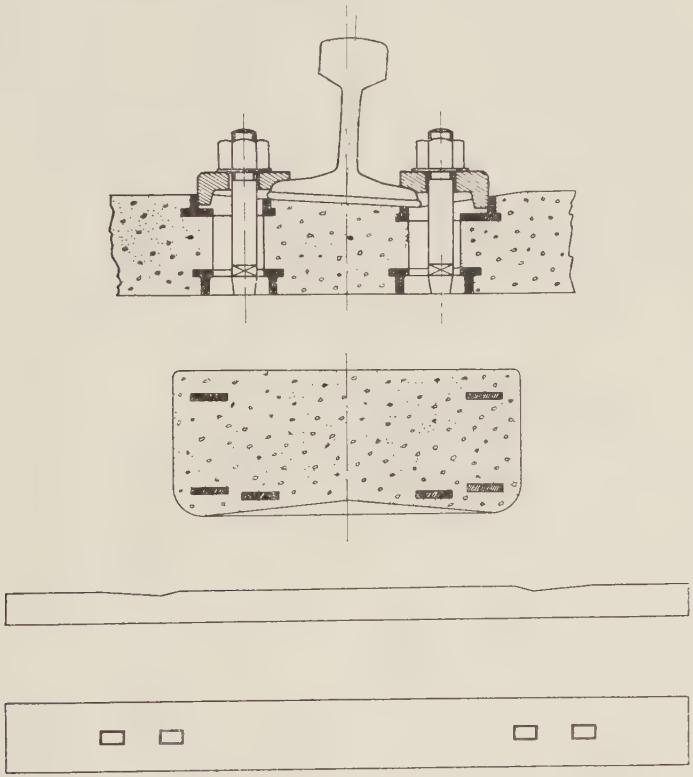


Fig. 21. — « Eternit » reinforced concrete sleeper, Italian State Rys.

Although reinforced concrete sleepers fall into two main types : a monoblock sleeper similar in appearance to a wood sleeper, or else two blocks or sleeper end-pieces joined by a tie-bar, there is in fact great diversity of kinds; this is due to certain details in their shape, the

arrangement of the reinforcement, the method of manufacture, and the way the concrete is made (ordinary or prestressed), and above all in the methods of fastening used.

Consequently instead of dividing this chapter in the same way as the previous ones, it seemed better to describe in turn the different types used or tested on the railways reporting their use, together with the method of fastening used in each case.

We will then give a few details concerning the new researches being made in France by the French National Railways.

2. *The different types used on some European Railways.*

a) *Belgium.*

The Belgian National Railways report:

— the use of reinforced concrete blocks of different types on sidings only (Category IV); the gauge is maintained by using an ordinary sleeper between every second pair of blocks. Fastening is by means of coachscrews through pyramidal oak dowels or plugs inserted in the concrete. The results obtained have been satisfactory;

— recent trials on a small scale of prestressed concrete sleepers supplied by various firms, the names of which were not reported. No details were given about the design except that they are fastened by means of sleeper clips on a webbed plate.

No technical specifications have been drawn up by this Administration.

b) *Italy.*

Many trials of transverse and longitudinal sleepers of all types have been carried out over the last 30 years. The results did not come up to expectations and the proposed types were given up. Only a new sleeper of the « Eternit » type (Fig. 21) which has been undergoing tests since 1937 and on a wider scale since 1942 is still being used. Its main characteristic is the method of fastening by bolts and clips, and its reduced thickness; 100 mm. ($3^{15}/_{16}''$) for a length of 2.50 m. ($8'2^{7}/_{16}''$) and width of 24 cm. ($9^{7}/_{16}''$) on the ordinary type, increased to 40 cm. ($1'3\frac{3}{4}''$) for sleepers at joints. No details were supplied concerning the design or construction of this type of sleeper. They report however that the tests so far made show that the bending moments are 200 to 250 000 kgr./m. under the rail and ± 50 000 kgr./m. in the middle of the sleeper.

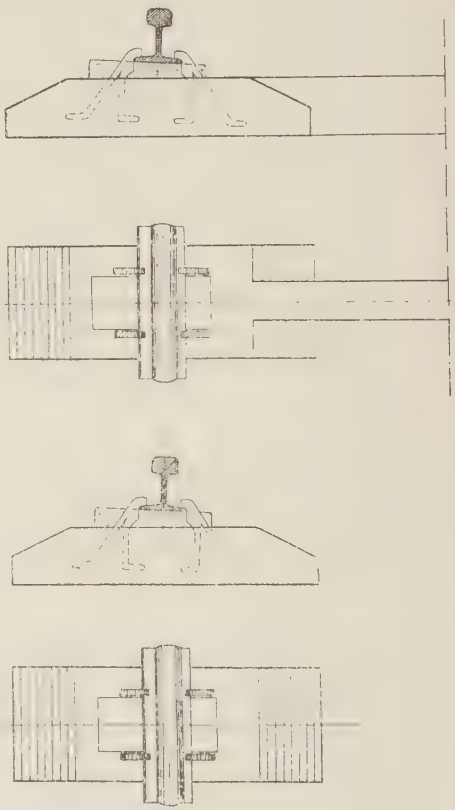


Fig. 22. — Reinforced concrete sleeper, Polish Railways.

c) *Poland.*

Trials have been made of sleepers and sleeper end blocks in this country ever since the first world war.

They are both used on the same track, 2 sets of blocks and 2 sleepers being used alternately; the latter consist of two blocks joined together by a tie-bar of some sort to assure the correct gauge being maintained.

Two kilometres of track have been laid in this way in Category I, and 5 km. entirely on sleepers in Category IV lines; additional large orders have been placed for sleepers and blocks for lines in Categories II and IV.

The permitted load is 7.5 t. (7.381 Engl. tons) per rail and the vibrated concrete must have a resistance of 300 kgr./cm² (4 266.99 lbs. per sq. inch). The rail is fastened by means of special angle irons embedded in the concrete and wedges in the form of wooden keys which are hammered under the rail foot (Fig. 22).

d) *Switzerland.*

Many tests have been carried out for the last 20 years, but the results obtained were unsatisfactory and the proposed types were abandonned.

Since 1944, three types of sleepers in prestressed concrete have been studied for lines in Category I; the following table gives their leading characteristics:

	Length. *m.*	*Width.* *m.*	*Thickness.* *m.*	*Weight.* *kgr.*
Type I	2.40	0.26	0.21	250
Type II	2.46	0.28	0.19	160
Type III	2.54	0.26	0.21	180

In types I and II, the rail is carried on a bearing plate which is separated from the sleeper by a plywood filler; in type III there is no bearing plate and the rail is carried directly on the plywood filler.

Fatigue tests are being carried out, and up to the present maximum stresses of ± 150 kgr./cm² (2133.498 lbs. per sq. inch) have been recorded in the middle of the sleeper, due no doubt to the vibrations set up in the sleepers which are not supported on the ballast in the middle.

e) *Czechoslovakia.*

Since 1936, on category IV lines, concrete blocks have been used connected together by two 20 mm. ($^{25}/_{32}$″) diameter irons (Fig. 23). The rail is fixed on hardwood blocks 130 × 140 × 250 ($5^{1}/_{8}$″ × $5\frac{1}{2}$″ × $9^{27}/_{32}$″) set in asphalt in the block. The load is 3 tonnes (2.952 Engl. tons) per rail, the resistance of the steel 38 kgr. (83.776 lbs.) and the mix 1 part of cement to 3 of small gravel. Results have been satisfactory.

f) *Jugoslavia.*

This Administration is proposing to use reinforced and prestressed concrete sleepers and blocks.

The characteristics of the sleepers to be used are : length: 2.402 m. ($7'10^{37}/_{64}$″); height 0.19 m. ($7\frac{1}{2}$″); width, lower face 0.28 m. ($11^{1}/_{32}$″), upper face 0.22 m. ($8^{11}/_{16}$″); weight 275 kgr. (606.271 lbs.).

Those of the blocks are : length : 0.60 m. ($1'11^{5}/_{8}$″); width 0.42 m. ($1'4\frac{1}{2}$″); height 0.19 m. ($7\frac{1}{2}$″); weight 120 kgr. (264.554 lbs.).

It is proposed to use a combination of sleepers and blocks as follows :

— on Category I lines : 1 sleeper — a pair of blocks;

— on Category II lines : 1 sleeper, 2 pairs of blocks;

— on Category III lines; 1 sleeper — 3 pairs of blocks.

The rail which rests on a webbed plate on the sleeper will be fastened by means of coachscrews inserted in wooden dowels fixed in the sleeper.

The steel used has a strength of 37-42 kgr. (81-92 lbs.); the gravel and sand must pass through 3, 1.5 and 0.1/15 mm. screens respectively; the proportions of sand and gravel will be between 1/1.8 and 1/2.

The cement used must show a resistance to compression of 500 kgr./cm² (7111.66 lbs. per sq. inch.) and a tensile strength of 30 kgr./cm² (426.699 lbs. per sq. inch.) after 7 days.

g) *France and Colonies.*

The French National Railways laid many reinforced concrete sleepers between 1920 and 1930. Three types are still in service : Calot, Orion and Vagneux, used respectively on :

Category of line.	*Calot.*	*Orion.*	*Vagneux.*
I	51.5 km.	1.5 km.	169 km.
II	48 km.	80 km.	186 km.
III	32 km.	50 km.	5 km.
Age of sleepers	20 to 25 years.	15 to 20 years.	15 to 18 years.

« *Calot* » *sleepers* are straight bars similar in appearance to wood sleepers, 2.40 m. (7′10½″) long, with a rectangular section of 0.30 × 0.16 m. ($11^{13}/_{16}$″ × $6^{5}/_{16}$″), reinforced with steel ø = 10 mm. ($^{25}/_{64}$″), weighing 230 kgr. (507 lbs.). They have given satisfaction as regards resistance, except at the joints on lines with heavy traffic; their fastenings, however, consisting of coachscrews inserted in cast iron dowels or screw plugs inserted in the sleeper when it is cast, have given trouble on lines with fast, heavy traffic, and on curves, where the plugs soon get loose owing to the disintegration of the concrete. Moreover the asphaltic product used to increase the adhesion between the plug and the coachscrew under certain circumstances becomes of such a consistency after a time that it becomes impossible to screw or unscrew the coachscrews.

These sleepers have been used in particular on certain Category II and III lines on the Nord and Midi systems.

In view of the drawbacks of the fastenings used, the French National Railways do not propose to make any more of them.

The « *Orion* » *sleepers* consist of a bar 2.20 m. (7′$2^{5}/_{8}$″) long, the ends of which, under the rails, have a section of 0.26 m. × 0.16 m. ($10^{1}/_{4}$″ × $6^{5}/_{16}$″), and the thinner middle part which is 0.13 m. ($5^{1}/_{8}$″), is curved upwards by 3 cm. ($1^{3}/_{16}$″) to prevent it packing down the ballast (Fig. 24). The chief reinforcement consists of twisted square steel bars to make the body of the sleeper adhere more firmly to the reinforcement.

The very simple method of fastening consists of coachscrews inserted in small blocks of hardwood fastened into the concrete, and there is an 8 mm. ($^{5}/_{32}$″) bearing plate of wood between the rail and the concrete.

These sleepers, although their static resistance measured in the manner laid down in the new technical specifications

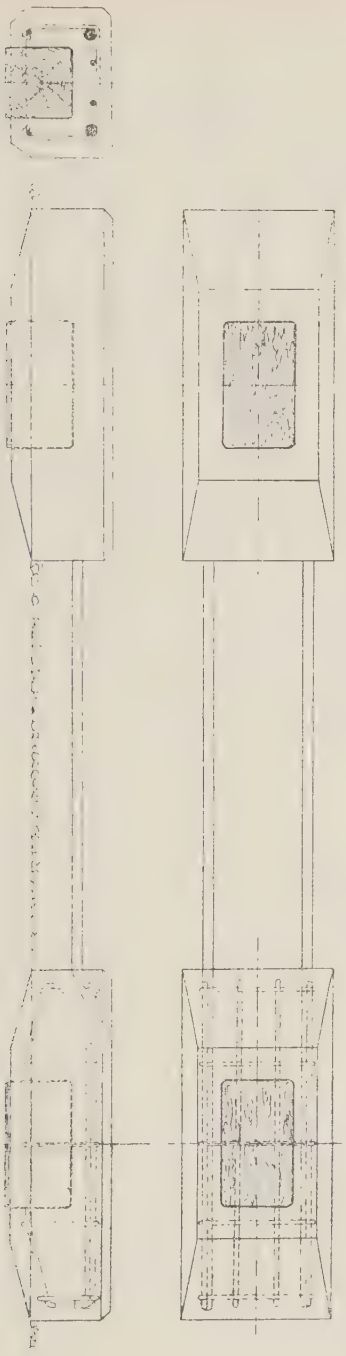


Fig. 23. — Reinforced concrete sleeper, Czechoslovakia.

of the French National Railways, the essential requirements of which are given further on, is only about 15 to 16 t. (instead of the 23 t. now stipulated), stand up very well in service. The only maintenance required is the replacement of the wooden plugs about every 15 years, an operation which unfortunately means turning over the sleeper.

The weight of Orion sleepers, 205 kgr. (452 lbs.), (235 kgr. [518 lbs.] for joint sleepers which are slightly reinforced) gives excellent stability to the track, so that it has been found possible to dispense entirely with the top layer of ballast, which is a considerable advantage owing to the ease with which shovel packing can then be done.

These sleepers have been used on some of the Category II and III lines of the old Midi system.

The French National Railways are now considering making more of these sleepers for lines with light and average traffic.

The *Vagneux sleeper* consists of two blocks 0.68 m. × 0.32 m. × 0.20 m. ($2'2\frac{3}{4}'' \times 1'^{9}/_{16}'' \times 7^{7}/_{8}''$) made of reinforced concrete, joined by a steel I.P.N. 80/42 channel fixed in the blocks, which it helps to strengthen (Fig. 25). The crosspiece is partly embedded in concrete, the wings being protected against corrosion by a special coating (usually of guttaterna). The weight of such a sleeper is approximately 185 kgr. (408 lbs.).

At first the fastenings consisted of coachscrews inserted in a metal spiral fastened in the concrete, with a wooden or rubber plate between the rail and the sleeper. This method only gave mediocre results, as the coachscrews got loose on curves. On the other hand, another method of fastening tried out on a large scale on Category I lines in the Sud-Est region over some 20 years has given excellent results; the ordinary coachscrew is replaced by a bolt-coachscrew;

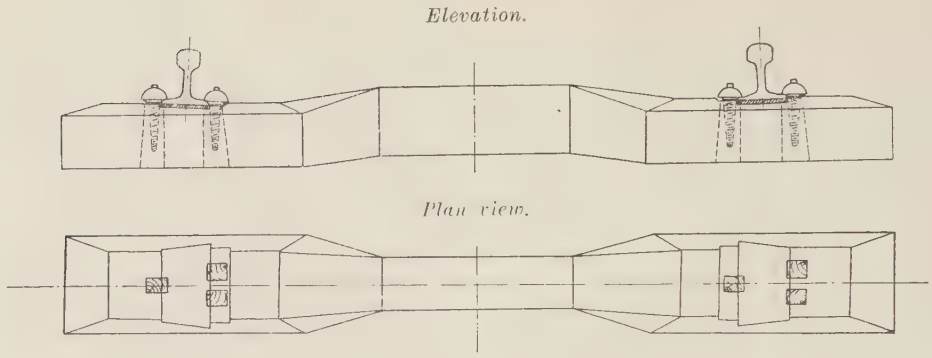


Fig. 24. — Orion sleeper.

the foot of the rail is held by a sleeper clip tightened up by a nut and spring washer; a combination of different sizes of clips makes it possible to regulate the gauge for all types of rails.

The Vagneux sleeper with this type of fastening having given good results, the French National Railways are now proposing to place orders for large quantities.

Static resistance tests recently carried out have proved that the Vagneux sleeper meets the technical specifications of the French National Railways, the breaking load exerted through the foot of the rail being of the order of 25 t. (24.605 Engl. tons).

The French National Railways have also used in sidings for many years reinforced concrete blocks of different types, some of them made out of old reinforced concrete sleepers.

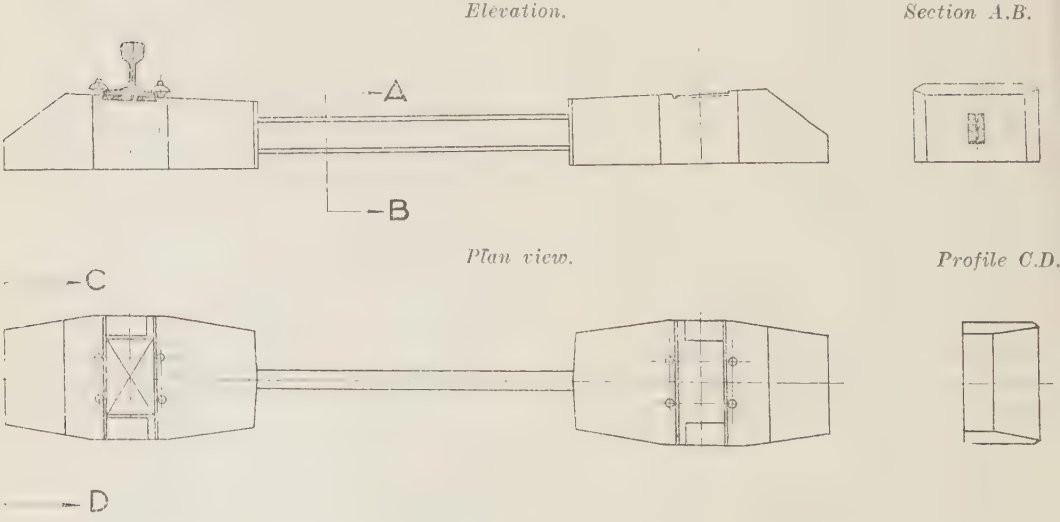


Fig. 25. — Vagneux sleeper.

The gauge is maintained by using an ordinary sleeper between every one or two pairs of blocks.

The secondary French Railways have not used reinforced concrete sleepers on any extensive scale, and the trials made since the 1914-1918 war have not proved very satisfactory. Those used were of the Calot, or Vagneux type, and the failure was due to the method of fastening, for the reasons given above.

In Algeria, Vagneux sleepers on Category I lines have been used successfully since 1936, with 46 kgr. (101 lbs.) S 33 rails.

In Indo-China, « Orion » sleepers, 1.60 × 0.20 × 0.14 (5′3″ × 7⅞″ × 5½″) have been used since 1936 on a narrow gauge line with 12 m. (39′4½″), 30 kgr. (66 lbs.) rails; there are wooden bearing plates between the rail and sleeper. On the whole they have proved satisfactory, but this railway reports that such sleepers decay owing to the corrosion of the metal near the sea. Perhaps the concrete used is of inferior quality or becomes disintegrated by the process of tamping.

In Tunisia Vagneux sleepers were laid on 17 km. (10.563 miles) of line in Category I in 1942, using poplar bearing plates between the 30 kgr. (66 lbs.) rails and the sleepers. These sleepers are made with 400 kgr. (882 lbs.) of cement; the strength of the concrete is 300 to 400 kgr. (631 to 882 lbs.) and the load per rail 28 kgr./cm² (398.253 lbs. per sq. inch) at the most. They have not been in service long enough to judge of their quality.

3. *The ballast used with reinforced concrete sleepers.*

Little of special note was reported, and we have not much to say about this.

The ballast used with concrete sleepers generally consists of crushed stone which will pass through à 4 cm. (1⁹/₁₀″) screen, and there is usually a furrow down the middle of the sleeper to prevent it tamping the ballast automatically.

The great weight of track laid on reinforced concrete sleepers makes it possible to reduce the amount of ballast considerably, whilst conserving the same degree of stability.

4. *Electric insulation of track laid on reinforced concrete sleepers.*

The railways consulted gave no information on this point.

Tests to measure the insulation carried out by the French National Railways on a section laid with « Orion » sleepers showed that the resistivity of such sleepers was about half that of wood sleepers, not quite sufficient to allow of reliable functioning of automatic signal circuits.

The designer of Vagneux sleepers on the other hand has brought out an insulating threaded fitting in synthetic fibre which gives excellent results when used in place of the metal fitting for fastening the coachscrew. Unfortunately under present conditions this device is very expensive.

Recent research work in France on the conductivity of concrete has proved that this is due above all to porosity. Progress recently made in the methods of making concrete, either by granulometric investigation or the methods used (high frequency vibratation under great pressure) makes it possible to make concrete of such a consistency that it becomes practically an insulator. Trials will be made on the line as soon as possible by the French National Railways who want to use prestressed concrete sleepers on the numerous lines equipped with automatic block using track circuits.

5. *New investigations carried out by the French National Railways into reinforced concrete sleepers.*

We think this is a good opportunity to describe the new investigations

undertaken by the French National Railways into reinforced concrete sleepers.

The French National Railways having at their disposal two ordinary types of reinforced concrete sleepers which gave satisfaction on lines with relatively slow, light traffic, wished to profit by the considerable advantages obtainable by applying prestressing to railways sleepers. Investigations made in collaboration with M. FREYSSINET and the « Société Technique d'utilisation de la Précontrainte » (S.T.U.P.) resulted in a sleeper being designed, which will be inforced with strands of wire stretched over concrete blocks embedded in the concrete of the sleeper : length, 2.32 m. ($6'8^{5}/_{16}''$), section 24 × 11 ($9^{7}/_{16}''$ × $4^{11}/_{32}''$), weight 150 kgr. (330 lbs.) (Figure 26).

The steel used is a thin wire with a high elastic limit — (160-180 kgr. = 353-397 lbs.) and of great strength (200-220 kgr./mm² = 127-139.7 Engl. t. per sq. inch.). The sleepers are prestressed at the time of manufacture by passing them over the blocks on which the skeins are wound.

The fastenings which experience has

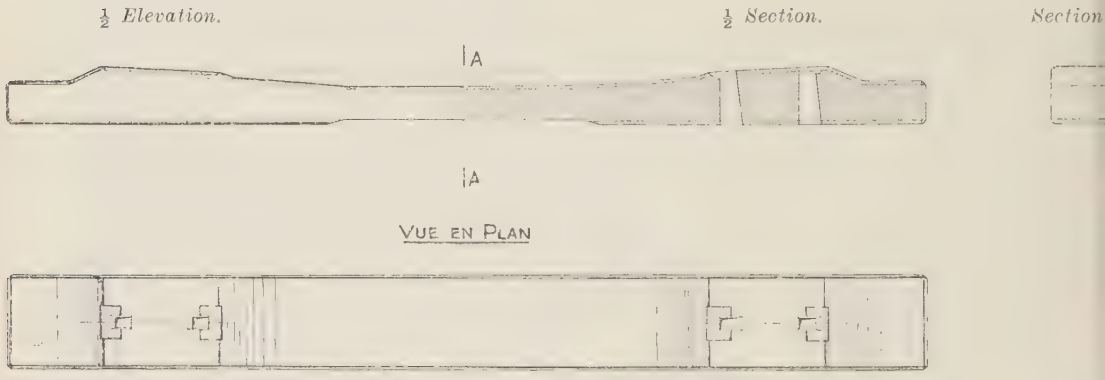


Fig. 26. — S.T.U.P. type sleeper.

Explanation of French terms :
Vue en plan - plan view.

described later on, the static resistance of which is at least 30 t. (29.526 Engl. tons) per rail foot.

Preliminary tests, carried out in the laboratory on lighter sleepers with a different type of reinforcement (parallel twisted wires), proved them to have great resistance to alternating stresses, and the flexibility of these sleepers, some 100 of which have been in service for over a year on a test piece of line has so far been satisfactory.

The design finally selected is as follows : straight beam made of high quality vibrated, compressed concrete, reshown to be the weak point of concrete sleepers have been specially designed, and the following is the method used :

— the rail rests in principle directly upon the concrete which is covered with a very thin layer of some plastic material, being secured by two sleeper clips. The original part of the design is the way the bolts are secured in the concrete. The ends of the bolts are in the form of a pyramid with a normal rectangular section; the two faces on the centre line of the sleeper have been given a slight inclination, while the two side faces are vertical. There are

four holes through the sleeper with the same flared-out shape towards the bottom, the section of which on the upper side of the sleeper is slightly larger than the largest lower section of the head of the bolt. This makes it possible to fit the bottom of the bolt into the sleeper. A wedge of compressed fibrocement placed between the bolt and one of the inclined sides of the hole assures that the bolt is held in place when tightened up.

movement of the rail in relation to the sleeper after several million alternating stresses.

Technical Specifications. — The French National Railways have drawn up two very strict technical specifications regarding the conditions under which sleepers are manufactured and delivered, one covering ordinary reinforced concrete sleepers and the other prestressed concrete sleepers.

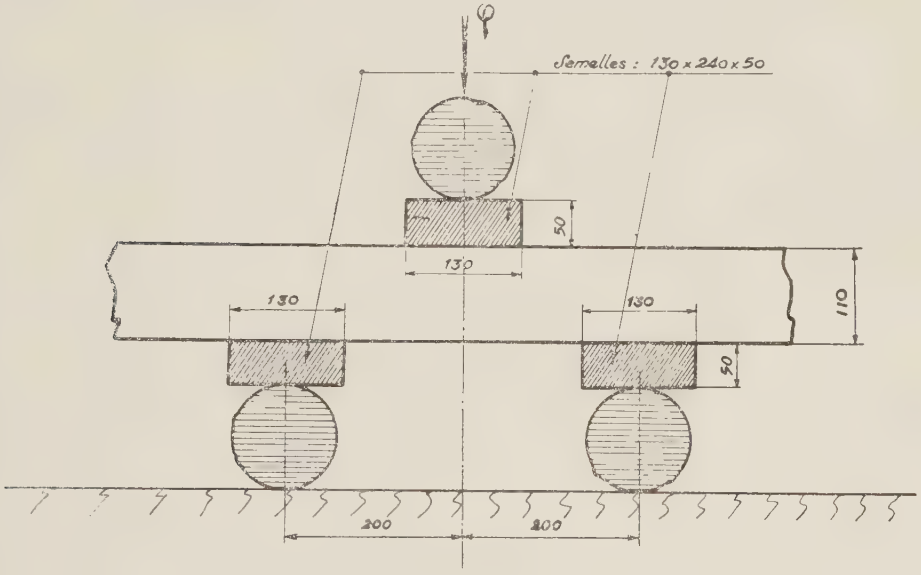


Fig. 27. — Testing a reinforced concrete sleeper.
Explanation of French term :
Semelles = bearing plates.

When the sleeper clip is tightened up, the end of the bolt is wedged very firmly until finally it is completely locked thanks to the stresses introduced along the sleeper when it is being tightened up.

Endurance tests carried out in the laboratory and tests on the permanent way, although of recent date, have proved that the bolt is really one with the sleeper and there was no measurable

These specifications have one part in common dealing with the preparation of the concrete itself.

The main points of these specifications are as follows :

Tolérances : ± 2 mm. ($^5/_{64}''$) in the distance between centres of the central holes which give the gauge;

± 0.5 mm. ($^5/_{256}''$) in the distance between centres of the holes on each side of the rail;

± 0.2 mm. ($^{1}/_{128}''$) in the interior sides of the holes;

+ 5 mm. ($^{13}/_{64}''$) — 0 on the transverse dimensions;

± 20 mm. ($^{25}/_{32}''$) in length.

Smooth outer appearance, without holes or cracks.

Aggregates : Sand free from earthy or marly matter, free running;

Hard gravel without earth, not frost cracked;

Cement having a high initial strength, reaching 160 kgr./cm² (2276 lbs. per sq. inch.) in 2 days, 315 kgr. (4480 lbs. per sq. inch.) in 7 days and 400 kgr. (5689 lbs. per sq. inch.) in 28 days.

The granulometric composition must be submitted to the French National Railways as well as the water/cement ratio, which will be submitted to laboratory tests to check that the maximum compactness has been obtained.

The measure of cement must be at least equal to 400 kgr./m³ (882 lbs./m³).

Completely mechanical manufacture of the concrete, with automatic measuring of the constituants and the water, to make sure there is no variation.

The actual strength of the concrete to be measured by means of cubes cut out of sleepers with no reinforcement must be at least 400 kgr./cm² after 28 days in the case of ordinary reinforced concrete, and 500 kgr./cm² (7111 lbs. per sq. inch.) in the case of prestressed concrete.

The steel used with prestressed concrete, the characteristics of which have been given above, must be submitted to a uniform tension of 150 kgr./mm² (95.23 Engl. t. per sq. inch.) ± 5 kgr., which is checked in two different ways when the work is done.

Delivery tests. The only test stipulated on delivery is a test under static load, taken on one sleeper in every 100, as shown in Fig. 27.

Each half sleeper must be able to carry without any cracks occuring a load of :

— 23 tonnes (22.636 Engl. t.) in the case of ordinary reinforced concrete sleepers on the running line;

— 25 tonnes (24.665 Engl. t.) for sleepers at joints;

— 30 tonnes (29.526 Engl. t.) in the case of prestressed concrete sleepers.

On one in every 1 000 sleepers this test is carried to breaking point to discover the effective strength of the sleepers.

Organisation of manufacture. — Ordinary reinforced concrete sleepers and prestressed concrete sleepers are as a general rule made by private firms under the supervision of the French National Railways.

The technical specifications are so strict that it is only possible to make such sleepers in the most up-to-date plants with improved equipment; automatic mixing of the concrete, vibrators, undeformable metal moulds, and improved equipment for handling the products, to make possible a very low cost price.

The French National Railways are planning equipping a certain number of centres throughout the country, sited to reduce transport. The first large scale plant designed for the manufacture of prestressed concrete sleepers, an experimental model of which has been built, will be equipped in a specially up-to-date manner for making the steel skeins, putting them under tension, vibrating the concrete and obtaining high compression in order to obtain perfect compactness, baking for rapid setting (taken out of the moulds after some 2 hours). This plant will run on continuous shifts, 3 per 24 hours, and the estimated production on which the cost of the sleepers has been based is 600 sleepers per 24 hours.

The French National Railways also intend to place orders with French industrial firms for prestressed concrete sleepers, the reinforcement of which will consist not of skeins but parallel twisted wires. The plant to mass produce these is already in existence. The fastenings of these sleepers will be the same as those already described.

By these large scale trials of a new type, the French National Railways admit that ordinary reinforced concrete sleepers if well designed and made with care, according to very strict technical specifications, will stand up perfectly over a very long period to service conditions on lines with average traffic from the point of view of speed and loads, on condition that the fastenings, the weak link, are well designed.

Concrete sleepers, nevertheless, have not the same flexibility and elasticity as wood sleepers, and as a result are ill fitted by nature, especially ordinary reinforced concrete ones, to stand up to the stresses of fast, heavy traffic. The French National Railways have therefore carried out investigations for improving the way elastic bearing plates are used in connection with permanent way laid on concrete. The use of elastic plates has however two drawbacks : everything else being equal, they appreciably increase the power needed to haul the trains, and they prevent the rail being held by rigid clips when a load is passing over it (1).

These two drawbacks can be eliminated to a great extent by using highly stressed elastic fastenings.

Under these conditions lines laid on reinforced concrete, being very heavy and stable, should be able to face up to the deformations due to internal stresses in the rails, and seems to be well adapted for use with very long welded rails.

6. *Track laid on longitudinals.*

As already stated very few railways reported the use of longitudinal supporting arrangements.

The method of fixing the rails on wooden longitudinal sleepers used on certain metal structures is not used on the running line; and it is no longer being used to the same extent on structures.

The French National Railways in particular when carrying out their reconstruction programme have preferred to use transverse sleepers on metal structures, or have tried to cover such structures with a concrete casing so that ordinary track on ballast could be used, or the track laid directly on concrete with or without sleepers, elastic bearing plates being used.

The use of concrete or reinforced concrete longitudinals with steel crossmembers on the running line is only reported by the French National Railways and Syrian Railways, and this only in the case of track laid with grooved or tramway type rails (S.E.I. for example) laid on paved roads, in particular in the ports.

This type of track is also used in many ports in the French Colonies, and is the classic method for urban tramway systems. Track laid in this way however can only be run over at low speeds, like the track in sheds or shops over pits which are also types of longitudinals with which we will not deal here.

The French National Railways have recently investigated the possibility of laying track for heavy fast traffic on reinforced concrete longitudinal sleepers. A section some 100 m. (328′1″)

(1) This has been particularly brought out during the measurement of stresses due to variations in temperature on a long rail laid on rubber bearing plates with rigid fastenings, a stress which was wiped out when the wheels passed over it and liberated the counter-stresses due to the fastening.

long has been laid as an experiment, and another 400 m. (1312'4") long is under construction.

These are « Laval » type longitudinal sleepers consisting of elements 1.25 m. (4' $1^{7}/_{32}$") long, 0.70 m. (2'$3\frac{1}{2}$") wide, 0.15 m. ($5^{23}/_{32}$") thick, so that the load is widely spread over the ballast. The rail is fastened by means of bearing plates laid on rubber fillers being fixed by means of sleepers clips and removable bolts. The gauge is maintained by ordinary wood sleepers inserted between the longitudinals or by cross pieces.

The first trial section on which the rails are welded into a single length 100 m. long, is only used by locomotives, such traffic being fairly frequent and heavy but slow. The level appears to be stable, thanks to the small unitary pressure transmitted to the ballast; this is maintained by rod ramming.

A second section is under construction on a Category II line, with welded rails 400 m. long and elastic fastenings.

* * *

Part 2.

MAINTENANCE METHODS.

The preservation of sleepers in the track is relatively better when the stresses to which they are subjected are lowered, and this state of things is so much more effectively achieved when the track is maintained in a good level condition. It has been shewn earlier that one of the causes of deterioration of sleepers is a defective method of rail fixing; it is therefore necessary for long life to provide effective maintenance in this respect.

We shall examine successively the methods of maintenance of level then of the fixing arrangements and their influence on the preservation of the sleepers.

CHAPTER I.

Maintenance of level.

I. Methods of maintenance of level.

The maintenance of track level is carried out :

— by shovel packing;

— by tamping;

— by re-bedding.

1. *Shovel packing.*

Shovel packing was first used by the British Railways and imported into France about 1910 by the « Nord » Railway. It was then carried out by successive approximations.

The method was improved, about 1928, to the measured shovel method by M. LEMAIRE, then Engineer to the French North Railway Company and now Director General of the S. N. C. F.; this method is being gradually standardised by all Administrations which use shovel packing (1).

It is at present used :

In France : on all S. N. C. F. lines of Categories I, II and III, and also on certain Category IV lines, whatever type of sleepers is used; at the same time, on certain Category III lines on which the amount of traffic does not justify the cost of a high degree of level maintenance, shovel packing is confined to joints, to the more highly stressed points or to certain places where the track is unstable.

In Belgium : on Category I, II and III lines, whatever the type of sleeper used.

(1) It may be recalled that measured shovel packing comprises the determination, by relatively accurate measuring instruments, of visible depressions (level and rod) or hidden defects (track recorder) and the introduction at the bed of the sleeper, called the « cast », a quantity of fine gravel sufficient to correct the fault. The introduction of the gravel is effected by means of the small flat shovel or, better, still, by the special packing shovel.

In Tunisia : on Category I lines laid on wooden sleepers (18 % of the total).

In Holland : on 80 % of Category I, II and III lines.

In Luxemburg : on 70 % of Category I, II and III lines laid on wooden sleepers.

In addition, the Paris Metropolitan, Polish, Rumanian, and Czechoslovakian administrations have recently undertaken, or have decided soon to undertake trials with this method, although they have not so far used measured shovel packing.

The Italian State Railways, which undertook trials of measured shovel packing before the war, report that they have abandoned the method, but give no reason. Further, the Algerian Railways, after using shovel packing have returned to tamping, which they consider preferable in view of the low density of traffic carried on their lines, the great extremes of temperature and the standard use of 36 m. (118′) welded rails.

For our part, we are not convinced that conditions such as these should limit the use of measured shovel packing. The method has now been perfected and has proved its worth. Apart from the two cases reported, all Companies which use it, or have tried it, have been satisfied. Whatever the class of line, or the stress on the track, it permits the achievement, with less physical effort from the platelayers, of better and more economical results than other methods. Certain Administrations hesitate to use measured shovel packing on track laid on metal sleepers; it is admitted that in this case its application is fairly delicate, but it is reported that the S. N. C. F. are now using it successfully by taking certain precautions and having a special arrangement of maintenance gangs.

2. *Tamping.*

Despite the development of measured shovel packing, the maintenance of track by tamping remains the general practice on Category IV lines of almost all Administrations, and on Category I, II and III lines of a large number of European Administrations; Austria, Denmark, Finland, Norway, Poland, Portugal, Rumania, Sweden, Switzerland, Czechoslovakia and Jugoslavia, to mention only the larger ones.

Fig. 28. — Drouard tamping tool.

Tamping is usually done manually with beaters or tamping picks when the ballast consists of broken stone or slag, and with forks or shovels when it consists of gravel, sand or ash.

At the same time, certain Adminis-

trations, Austria, Italy, Norway, Poland, Sweden, Switzerland and Czechoslovakia are using or considering the use of pneumatic or electric tampers. Those most used are the Scheuchzer, Krupp, Drouard and Collet. Neither of the users of the Krupp tampers (Austria and Czechoslovakia) provide a description of it.

The Drouard tampers (Fig. 28) comprise a trolley running on the track on four rollers, a 4 H.P. petrol engine which works an air compressor operating the piston, to which is coupled the tamping head. Each tamper has four heads and two tampers working simultaneously and operated by eight men, can deal with 60 m. (197′) of track per hour of effective work.

The Collet tampers (Fig. 29) comprise a generator, mounted on a trolley running on the side of the track and feeding two electric motors mounted vertically on a monorail trolley. Through pinions, floating shafts articulated with cardan joints, cams which lift the beaters against the compression of powerful springs, each of the two motors can work four tamping heads at a rate of 1 250 strokes per minute. A total of eight workmen can cover an effective distance of 60 m. (197′) per hour.

The Krupp, Drouard and Collet tampers have given good results, but it appears that the most recent mechanical tamper, the Scheuchzer, may be even better. This machine (Fig. 30), no longer uses hammer blows, but makes use of vibration in raking the ballast under the sleeper. The whole machine comprises a chassis carrying the motor, the mechanism for working the eight double tampers and a transmission between the engine and the wheels to allow the engine, when not in use for tamping, to drive the trolley.

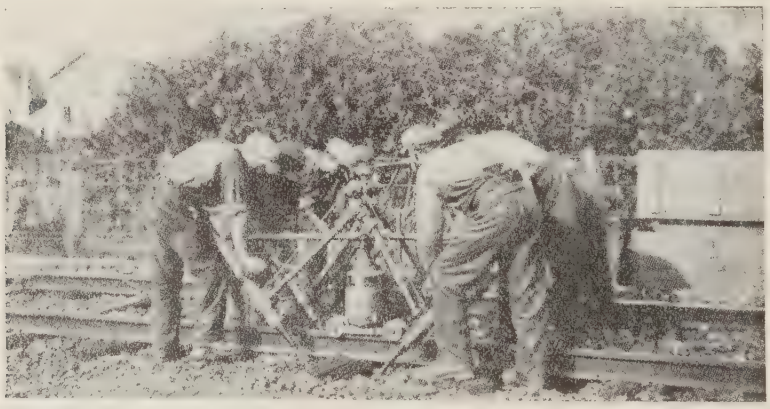


Fig. 29. — Collet tamping tool.

In the working position, the tampers have two simultaneous movements, one a high-frequency vibration (1 500 per minute), the other a slide, which draws them together in pairs whilst raking the ballast under the sleepers until the maximum effort is attained, when the mechanism is automatically released. The tamping of a sleeper being completed, the eight heads are lifted and the machine moves along to the next sleeper. Only one operator is required to drive and control the machine, which can deal with 100 m. (328′) per hour.

3. *Re-bedding.*

Maintenance of tracks by re-bedding, or underpinning, is done in France only when the lift required is considerable, and where measured shovel packing would not meet the case (super-elevation of a curve after rectification, low or packed bed needing lifting, anchoring sleeper only, so that the gravel laid can be shovel-packed whilst resting on the untouched ballast.

4. *Limits of shovel packing or tamping.*

Whatever the method of maintenance of rail level, the Administrations confine themselves to shovel-packing or tamping

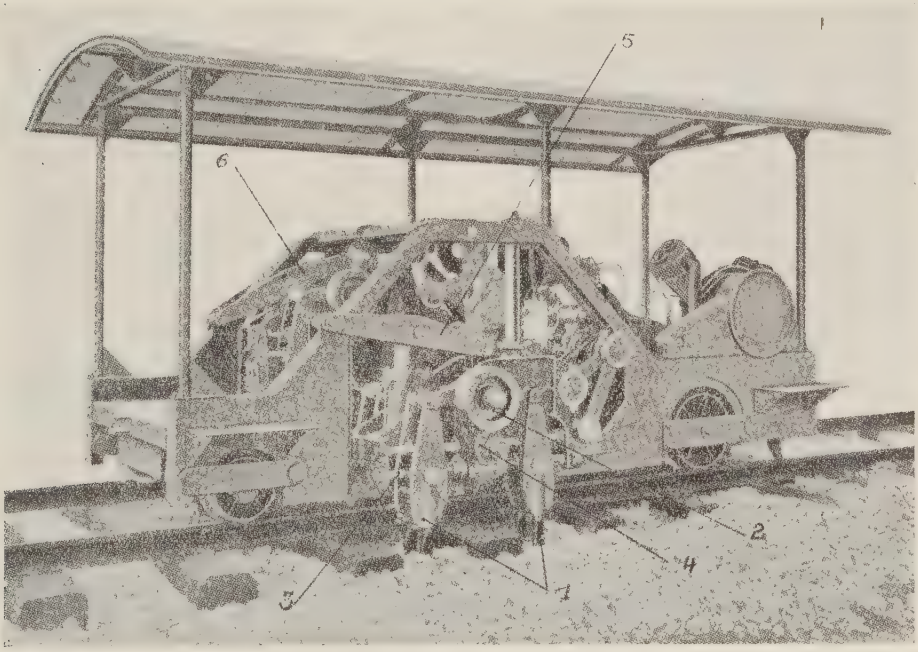


Fig. 30. — Scheuchzer tamping tool.

of sleepers laid experimentally, quick restoration of line). It is also systematically used after renewal of track laid on reinforced concrete sleepers.

This method of maintenance consists of the introduction of a quantity of gravel, corresponding to a general raising of 3 — 5 cm. ($1^{3}/_{16}''$ — $1^{31}/_{32}''$) under the sleepers. The preliminary opening-up is often done on one side of the 30 to 50 cm. ($11^{13}/_{16}''$ to $1'7^{11}/_{16}''$) on each side of the rail, and do not touch the central part of the sleeper.

At the same time, the Swedish Railways deal with the full length of the sleeper without experiencing any difficulty, and the Italian State Railways report that they have done so with joint sleepers; this method does not appear desirable to us, however, as there is a

risk of supporting the sleepers by the centre, and so rendering them liable to pivot or break.

5. *Levelling of re-laid track.*

The information furnished by the Administrations on the maintenance of level on lines newly re-laid is as follows :

Belgium : after the formation of casts, a deposit of 20/30 gravel over 5 to 7 cm. ($1^{31}/_{23}''$ to $2^{3}/_{4}''$) to fill up hollows, then shovel-packed.

Holland : after stabilisation of the track, shovel packing is used, but only after 2 or 3 years.

Luxemburg : re-bedded, then 2 — 3 years later shovel-packing is used again. In the case of mechanically-tamped track, shovel-packing is used.

Switzerland : mechanically-tamped one year after renewal, then an interval of 3 to 5 years before recommencing normal maintenance with hand-tamping.

Czechoslovakia : two or three weeks after definite consolidation after two successive tampings — a complete tamping is effected and then a two or three years' interval before normal maintenance.

France : on the S. N. C. F. lines the normal maintenance cycle is recommenced only when the casts have assumed a satisfactory consistency. At present the tendency is as follows : in the six months following the definite consolidation of the renewed line, when the line has received attention for six weeks to ensure that a satisfactory bed has been achieved, a mechanical tamping with a Scheuchzer tamper, or a gravel re-bedding is given. The normal maintenance cycle is then followed.

6. *Influence of level maintenance methods on the sleepers.*

Those administrations which use both measured shovel and tamping methods report that wooden sleepers tamped by hand with beaters have their lower edges quickly worn off and the bottom surface tends to become rounded, so decreasing the degree of stability. This defect does not reveal itself with shovel packing, the bottom of the cast being permanently protected by fine ballast.

Reinforced concrete sleepers must not be hand-tamped as they would deteriorate rapidly and the concrete would chip away at the lower edges and uncover the reinforcing rods.

The drawbacks to hand tamping are not experienced when using Scheuchzer mechanical vibration tampers.

7. *Level of the ballast in relation to the top level of the sleepers.*

Most of the Administrations consulted report that the top level of the ballast lines up with the tops of the sleepers both inside and outside the track.

Exceptions to this rule are :

— Matadi-Leopoldville : outside the track the ballast is level with the head of the rail.

— South Funen : the ballast — when gravelled — is 3 to 4 cm. ($1^{3}/_{16}''$ to $1\ ^{9}/_{16}''$) below the top of the sleepers.

— S. N. C. F. : inside the track the ballast is 5 cm. ($1^{31}/_{32}''$) below the top of the sleepers. This dimension is maintained up to 15 cm. ($5^{29}/_{32}''$) from the rail axis towards the outside, then the ballast reaches the top level of the sleeper. This arrangement is used with both wood and metal sleepers. With concrete sleepers the ballast is only level with the bottom of the sleepers.

— Paris Metropolitan : the ballast is kept below the top of the sleepers, 2 — 3 cm. ($^{25}/_{32}$" — $1^{3}/_{16}$") between stations, 4 cm. ($1^{3}/_{16}$") at stations.

— Holland : the ballast is kept 2 — 3 cm. below the top of the sleepers.

— Italy : State Railways and Nord-Milan — outside the track the ballast is 10 cm. ($3^{15}/_{16}$") above the sleepers.

II. Frequency of attention.

Track level maintenance is carried out by the Administrations either systematically at stipulated periods, or only at points where attention becomes necessary. The first method is becoming more general, but certain large Administrations, such as Czechoslovakia and Switzerland, still use the second method. In Switzerland the method is improved by the use of a recording wagon which runs over all Category I and II lines each year, and records in running at each point the deflection of curves, cant, gauge, deviations and slacks on each set of rails. This information is recorded graphically and provides data for the programme of work and its degree of urgency. In France, the S. N. C. F. takes a similar recording but this serves mainly as a guide to the state of the permanent way, rather than as data for the maintenance programme, most of which is periodical.

Amongst the Administrations undertaking periodical and methodical maintenance are :

Belgium : measured shovel packing twice a year on important lines;

Denmark : hand or mechanical tamping 2 — 5 years intervals, according to the importance of the line;

Paris Metropolitan : tamping every two years on Category II lines; on Category III lines, every two years on viaducts, every 3, 4 or 5 years, according to the age and profile, on underground lines;

Tunisia : tamping twice a year;

Holland : two-yearly measured shovel packing;

Luxemburg : yearly measured shovel packing on Category I lines, two-yearly, measured shovel packing on Category II and III lines;

Sweden : yearly, or even twice-yearly, tamping on certain lines.

The rate is therefore very variable, and shows no rule common to the various Administrations.

In France (S.N.C.F.) level maintenance is carried out under the following conditions :

a) on important lines (corresponding to Category I), 25 % of the total length with general lifting during general overhaul (1),

60 % of the total length without general lifting during light overhaul (1).

b) on lines corresponding to Category II, 22 % of the total length with general lifting.

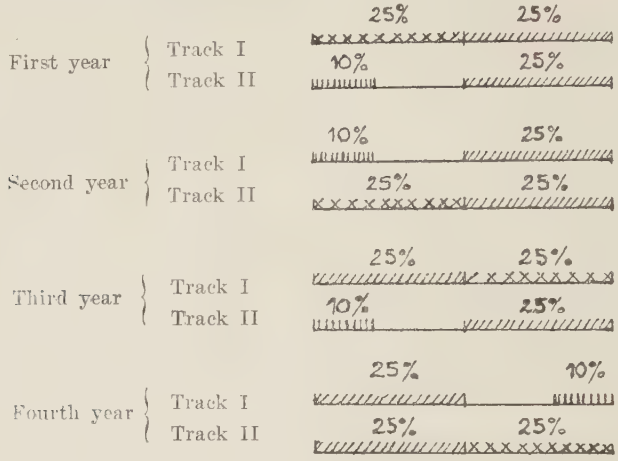
c) on Category III lines, 20 % with general lifting, 40 % without general lifting.

The rate of level overhaul is, therefore :

	Category I.	*Category II.*	*Category III.*
With general lifting	4 years.	4 1/2 years.	5 years.
Without general lifting	1 2/3 years.	2 years.	2 1/2 years.

(1) A definition of light and general overhauls is given later.

On a double track, Category I line, for example, the complete overhaul cycle can be shown graphically :



Note : — ××× = with general lifting.
////// = without general lifting.

Permanent way staff are instructed each year to carry out levelling with lifting (25 %) and a part of levelling without lifting (25 % twice) on continuous given lengths and to arrange in addition a 10 % levelling without lifting on locations chosen by themselves from the length dealt with and lifted the preceding year.

CHAPTER II.

Maintenance of sleepers and arrangement of fittings.

The methods of level maintenance are generally the same whatever type of sleeper is used; it is obviously not the same for the sleepers themselves, differing when they are of wood, steel or concrete.

I. Wooden sleepers.

1. *Repair of wooden sleepers.*

The necessity for economising in sleepers at all times, but particularly during and since the war, and the need to limit as much as possible replacements which, whatever the precautions taken, more or less destroy the track level, have for a long time led Administrations to undertake numerous sleeper repairs in the track. These operations are, moreover, much easier when the wood can be dealt with by operatives of medium ability, which is one of the indisputable advantages of this class of sleeper.

The parts which require attention are those carrying the fittings particularly the seating on track laid without chairs or soleplates and cracks or splits.

A. *Repair of fittings.*

Rail fittings on the sleepers are re-tightened periodically and methodically. The frequency of this attention varies between six months and two years according to the Administration. The most general rule on Category I lines is an annual re-tightening during which

it is decided which of the fittings are in need of consolidation owing to them not fulfilling their function.

In France (S.N.C.F.), the maintenance of track is undertaken in a methodical manner by general overhaul, light overhaul or partial repair.

General overhaul, apart from rectifying the level by general lifting, comprises the repair and replacement, where necessary, of the whole of the material (weeding and cleaning of ballast, correction of the alignment of the track, inspection of joints and fishplates, replacement of sleepers, rails, clips, bolts, keys, coachscrews, consolidation of fittings, re-adzing, correction of position, etc.).

Light overhaul includes levelling without general lifting and simple retightening of fittings, excluding replacement or consolidation of items (in practice, nothing is done which can be left until the next general overhaul). Partial repair outside methodical overhaul is very limited, and used only on those portions of the track where it is not possible to defer the attention until the next light or general overhaul.

The methods used in the consolidation of defective fittings are :

a) *replacement of a coachscrew by another coachscrew of larger diameter :* This method, the most simple, is used when the timber is sound and only the screw or the hole is worn. It is at present used in France, where 23 mm. ($^{29}/_{32}''$) coachscrews are replaced by 26 mm. ($1^{1}/_{32}''$) ones.

b) *use of A.S. (1) bushes :* The use of this method is reported by the S.N.C.F., the French Light Railways, the Paris Metropolitan, Tunisia, Algeria, Holland and Italy. It is used when the wood is sound and it is not necessary to drill a fresh hole. An insert of malleable metal (aluminum or brass), V-shaped, fills up the thread made by the coachscrew. This device allows the superimposing of several bushes on one coachscrew and hence the use of coachscrews of increasing diameters. In fitting, use is made of a coachscrew mandrel and brace; the mandrel having a diameter slightly less than the normal coachscrew so that the interior diameter of the thread will be slightly less than a normal coachscrew, which will thus have a reasonable grip. After screwing on the mandrel the bush is fitted in the old hole in the previous thread. The bush being in place, the mandrel is withdrawn and the coachscrew is then driven into the bush.

c) *blocking of the existing hole and drilling of a new hole :* This is the oldest method and most commonly used when the timber is well worn or unsound and when the holes are worn oval by the movement of the coachscrew. It has the drawback of decreasing the solidity of the sleeper. The old holes are cleaned up with an auger and blocked with a hardwood dowel, cylindrical (Denmark and Switzerland), octagonal (Algeria and Czechoslovakia), square for round holes (France, S.N.C.F., Tunisia, Holland) or rectangular for oval holes (France, S.N.C.F., Tunisia).

d) *plugging of worn holes and redrilling :* The old hole is cleaned up with an auger of suitable diameter and a plain hardwood dowel, round, square, rectangular or octagonal, is inserted in the hole. The plug is drilled and the coachscrew is driven in. Certain Administrations also use dowels drilled in advance and inserted with the aid of a special mandrel. This method is used when only a part of the wood is unsound and can be replaced by healthy wood. The various Administrations generally have some latitude in the design of trenails or dowels used, as

(1) A.S. = initials of the inventor : Albert Streit.

in the case of the S.N.C.F. which use with 26 mm. ($1^{1}/_{32}''$) coachscrews plain trenails of square pyramid section (26/26 — 23/23) or rectangular (26/29 - 23/26) or drilled dowels, also square or rectangular of the same dimensions. The rectangular trenails are used in the case of oval holes, the larger dimension corresponding to the large axis of the oval. Drilled dowels have the advantage of being pierced in advance with a clean hole of exactly the same dimension as the coachscrew diameter, but their insertion and adjustment are much more delicate.

Most Administrations use this method both with dogspikes and with coachscrews and report satisfaction. At the same time, one Swedish Administration (Norsholm — Västervik — Hultsfred) report that they have discontinued the use of spikes as they appeared less safe; it may be noted that this refers to softwood sleepers in a Northern country rich in timber, which does not hesitate to scrap sleepers which in other countries would be repaired and re-used.

In Czechoslovakia special hollow trenails in impregnated beech are used. The top part is conical, to provide a better plug for the old hole, the central and lower parts are notched to increase resistance to withdrawal; elasticity is improved by slots in the lower part. Trenails used with coachscrews are 118 mm. ($4^{21}/_{32}''$) in length, 35 mm. ($1^{3}/_{8}''$) thick and the conical hole is 15 mm. ($^{19}/_{32}''$) diameter at the top and 8 mm. ($^{5}/_{16}''$) diameter at the bottom. The same sizes for trenails used with spikes are 170 mm., 37 mm., 17 mm. and 10 mm. ($6^{11}/_{16}''$, $1^{29}/_{64}''$, $^{43}/_{64}''$, and $^{25}/_{64}''$) respectively.

The Swiss Railways use round dowels with coachscrews and square with round holes for spikes.

The use is also reported, for correcting canted coachscrews, of hardwood or bakelite wedges which are inserted in the coachscrew hole on the appropriate side. This method was used on the French Est system and has been kept in use on the corresponding region of the S.N.C.F.; it is also reported in use by the Portugese Nord and the Paris Metropolitan. The Swedish State Railways use such wedges, in « Masonite », 160 × 12 × 3.5, on Category I lines with elastic railspikes, before retightening.

Finally, from France (S.N.C.F.) the

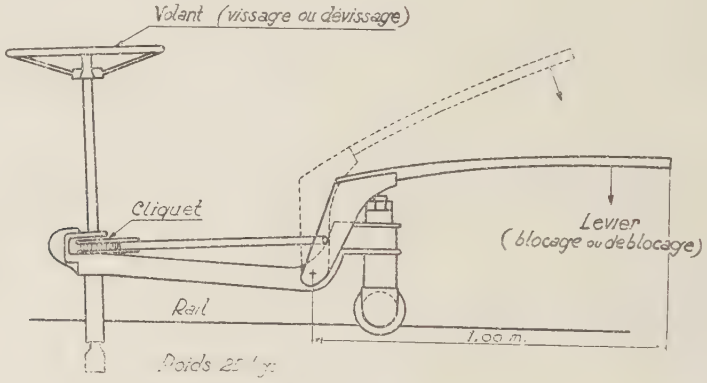


Fig. 31. — Lompret Guilk coach-screw spanner.

use of «philplug» is reported; a cement-asbestos product, obtained in fibrous form and made pliable by damping; it is inserted in the hole — whatever its shape — and packed to capacity. By means of an appropriate mandrel a grip is provided in the insert with a thread suitable for the coachscrew to be used, and of a slightly smaller diameter. The coachscrew, when inserted compresses the plastic bushing without deforming it, and the re-hardening is complete in about two hours.

Effective tightening of fittings and of the Lompret-Guille type (Figure 31) a frame, carries a support and roller, and a coachscrew spanner operated by a shaft carrying a flywheel, and an articulated lever. The lever allows the plugging and unplugging of the coachscrew, these operations being particularly irksome to do by hand, and the screwing and unscrewing are done by the flywheel. Two persons are required for its operation, and the machine can deal with 60 m. (197′) of track per hour without strain in a perfect and regular manner.

Fig. 32. — Petrol driven coachscrew spanner.

where necessary, their repair, are as essential as levelling in the maintenance of track laid on wooden sleepers.

Their frequent replacement and the labour cost involved, have led certain Administrations to consider the use of mechanical processes. Whilst the use of hand spanners remains the general rule, the use of mechanical coachscrew spanners is increasing more and more. In France (S.N.C.F. and Somain-Anzin) use is made of improved hand-spanners

Mechanical screwers are used only in exceptional cases for maintenance, but their use is now general in large repair and renewal works, in combination with other machines, bevellers, adzing and drilling machines, which will be dealt with later. The great difficulty in the consideration and use of these devices rests in the fact that the screwing up of the coachscrews must be stopped when the head comes into contact with the foot of the rail, any

increased effort tending to wrench out the thread in the timber, and also to the eccentricity of the point of contact of the coachscrew by comparison with its axis which throws it out of alignment. This drawback can be avoided with the ordinary spanner and with the Lompret-Guille machine, which both permit control of the screwing effort; mechanical devices must have some arrangement for the same purpose, controller, automatic brake, etc.

1 200 — 1 400 screws per hour, or covering a distance of 120 — 130 m. (394′ — 426′) according to the amount of work.

B. *Repair of rail seats and shoulders.*

As already shewn in Chapter II (8) of Part I, a flat-bottomed rail rests by its base directly on the sleeper (with or without a bearing insert) or on a metal soleplate. The mechanical wear on the sleeper gives rise to a sinking of the

Fig. 33. — Electric coachscrew spanner.

Automatic spanners are of two types :

— petrol-driven, consisting essentially of a chassis mounted on three bearing rollers running on the rail, a rigid, universally-pivotted frame, a mobile petrol engine on the frame, a rotating spanner with automatic braking and a flexible transmission between the motor and the spanner (Fig. 32).

— electric, built, on the same principles but with an electric motor, generator-driven, running on the side of the track. The power unit generally operates four or six spanners, being connected to them by rubber-insulated cable (Fig. 33).

The capacity of these mechanical spanners, with one operator, is about

rail into the sleeper, but to a lesser degree with the use of a soleplate.

In the latter case, and when the sinking is regular, it is sufficient to rescrew periodically the fixing of the soleplate to the sleeper, and if necessary to put it into good order.

If the sinking is irregular, which is generally the case on small radius curves, it can give rise to variations in the gauge and to canting of the rail to a degree injurious to the track. In this case it is necessary to release the sleeper, dismantle the soleplates if necessary and re-adze the rail seat.

This work is done by hand, by maintenance staff, with adzes. The defect is generally not widespread, and

the re-seating operation is not a common one. When several successive sleepers require re-adzing, it is preferable to lift the rail; this is a delicate and unusual operation which is justified only in cases where the defect is continuous along a section. It is therefore preferable, in order to avoid complete renewal of the sleepers, to carry out any mechanical re-notching in the track.

When the rail is not laid on soleplates, the gauge is maintained by the shoulders of the rail seats; the rail beds gradually into the wood, the coachscrew heads, periodically tightened, come into contact with the shoulders, and the rail fixing becomes unsafe. There are three remedies :

a) Insertion of packing between the foot of the rail and the rail seat; the packings may be 2 to 5 mm. ($^{5}/_{64}$″ to $^{13}/_{64}$″) thick rubber, or 4 to 5 mm. ($^{5}/_{32}$″ to $^{13}/_{64}$″) thick bakelised, impregnated or processed wood. The Dutch Railways report that they have abandoned the use of rubber inserts because of the

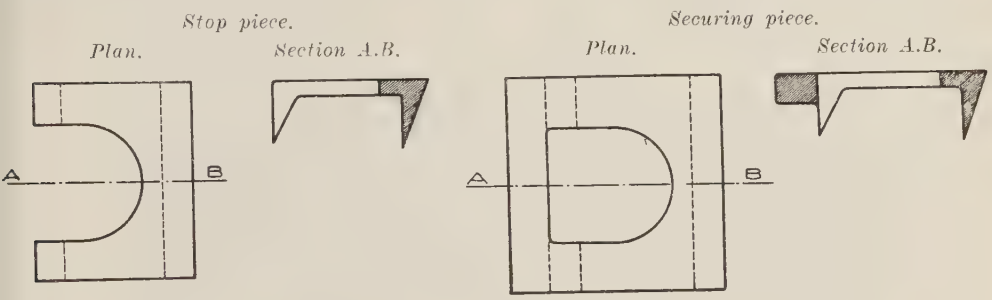


Fig. 34. — Ramy cleats.

Fig. 35. — Pouget mechanical adzer combined with Pouget coachscrew spanner.

injurious effect of the creosote on them. The other Administrations which use rubber inserts have not reported any defects, even after trials covering several years.

b) Use of Ramy cleats. These are small steel plates provided with spurs and ribs drilled through, which are set on the shoulder; the spurs engage in the wood and are held in place by the coachscrew collet. There are two types of cleat, on one (Fig. 34) the rib holds the foot of the rail, prevents its displacement in a transversal direction, and prevents the displacement of the coachscrew; on the other the foot of the rail is held both transversally and vertically by the rib, and the head is supported on the cleat; the rail is wedged and held to gauge; the coachscrew cannot tilt and the holes therefore do not become oval. The advantage of these cleats is that they put off the recutting of the wood.

c) Re-cutting of shoulders; whatever may be the advantages of the first two methods, particulary in regard to preventing any weakening of the sleepers, they are not very widely used, since only France, Holland, Paris Metropolitan, Poland and Switzerland report the use of the first, and only France and Tunisia employ the second.

Fig. 36. — Cantin adzer.

The most common method is therefore the recutting of the shoulders, or notching, done almost everywhere manually by adzes. The Norwegian Railways report the use of Robel planers and the S.N.C.F. use mechanical adzers; a rotary head provided with cutters and driven by an independant motor (Pouget), or by an electric, generator-fed, motor (Cantin), revolves on an axis perpendicular to the shoulder, planes the deteriorated section of the wood and renotches the shoulder to a level precisely regulated by comparison with the rail. As the re-adzing necessitates the

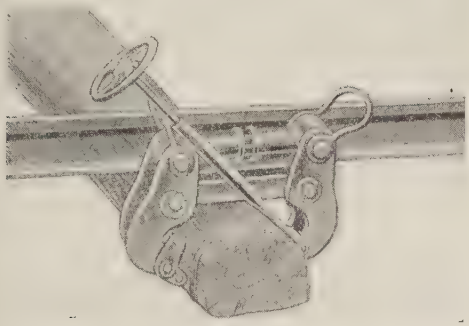


Fig. 37. — Hooping of sleepers — Delor process.

preliminary removal of the coach-screws, they are generally used along with mechanical spanners. The Pouget adzer-spanner (Fig. 35) not only achieves this combination but also stabilises the adzer and the spanner, but the efficiency of the first is reduced by the relatively slow progress of the second. For this reason the Cantin adzer (Fig. 36) is separated from the spanner. Normally a generator feeds two adzers and four spanners; one adzer per line of rail, one spanner behind the adzer, one in front; the capacity can then, with 19 men, reach 700 m. (2296′) of track per day, or more than three times that done by hand and of a much higher standard and quality. The Cantin adzer comprises a frame running on the rail by means of three vertical rollers and held laterally by four horizontal rollers, the position of two being adjustable. The frame also carries the rotating head, the height and position of which are adjustable, the power unit and the transmission.

These machines are at the moment used only in large works, but the economies effected and the neatness of the work done lead us to think that they will also be developed for maintenance work.

C. *Repair of cracks and splits.*

Apart from cracks produced in manufacture, the remedies for which have been dealt with in Chapter II, § 7, they also appear gradually in use. The Administrations attribute them mainly to alternate wetness and dryness, accentuated — according to the report of the Somain-Anzin Railway — by insufficient protection from the sun. They attribute them also to the stresses on the fittings, particularly when these are subject to multiple repairs carried out with insufficient precision (too large coachscrews or trenails). The repair of these cracks is carried out on the track, using bands completely circling the sleepers, by the S.N.C.F. the French

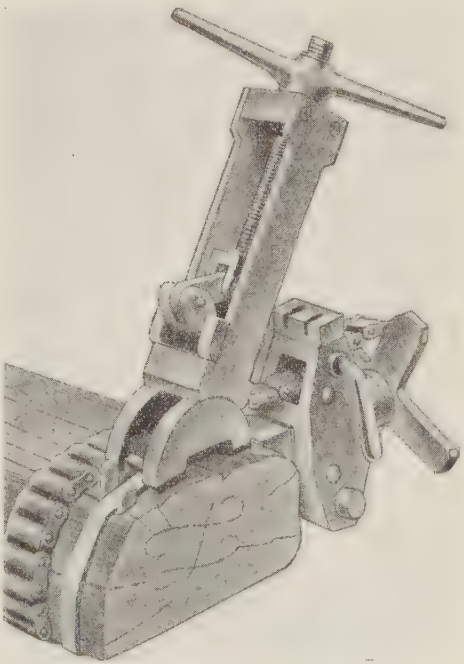


Fig. 38. — Hooping of sleepers — Gibert process.

Light Railways, the Paris Metro., Algeria, Luxemburg, Norway, Poland, Switzerland and Czechoslovakia. Italy alone still uses S-shaped steel forgings, but this latter method whilst preventing the cracks from opening out, does nothing to close them.

In France, two methods are used, the Delor and the Gibert, which differ essentially in the type of band. The Delor band (Fig. 37) is of mild steel, 16, 20 or 26 mm. ($^5/_8$", $^{25}/_{32}$" or $1^1/_{32}$") wide, 3, 4 or 5 mm. ($^1/_8$", $^5/_{32}$" or $^{13}/_{64}$") thick, with a steel buckle at one end. The Gibert band (Fig. 38) is a steel strip, tempered and galvanised of 4.4 mm. ($^{11}/_{64}$") diameter, one end being bent over to form a buckle. The banding of cracked sleepers in the track is carried out in the following manner : clearing of the end of the sleepers, removal of the S irons, bolts, and cleaning of the cracks with a special hook, fitting and tightening by means of a cramp, compressing the sleeper and closing the cracks, fitting of the band previously cut to the required length and bent round the sleeper, tightening of the band by means of a special wrench, fixing of the band, removal of the cramp and replacing the ballast.

This method, which has given excellent results, is economical and can be easily carried out by moderately-skilled staff.

The other Administrations which use banding do not give any details. Only the Swiss Federal Railways report that they use mild steel bands 50 mm. ($1^{31}/_{32}$") wide and about 2 mm. ($^5/_{64}$") thick.

2. *Replacement of wooden sleepers.*

The rules vary from system to system. Some, rich in timber, carry out practically no repairs to damaged sleepers, and systematically replace those which appear weak; this is the case with certain Swedish and Finnish Administrations, where the fittings suffer little fatigue and the principal cause of deterioration is rot; an annual sounding (sound given by the sleeper when tapped with a pick or bar, control by testing with a borer) determines those to be replaced. The large majority of Administrations, however, adopt the following rules, which are those of the S.N.C.F., or similar ones :

a) replacement of broken or burned sleepers;

b) replacement of perished or overdried sleepers in which coachscrews, even after consolidation, have no longer the grip necessary for the correct fixing of the rail. In particular, sleepers which have had three holes drilled on the same side of the rail and in which it is necessary to drill a fourth for correct rail fixing are replaced;

c) replacement of sleepers having insufficient thickness for the rail (less than 8 cm. [$3^5/_{32}$"] on the S.N.C.F.);

d) replacement of sleepers warped to such a degree as to need straightening which would impair the track or lack stability.

The Paris Metropolitan report more restrictive rules as regards the thickness of the sleeper under the rail; 11.4 cm. ($4\frac{1}{2}$") on Category II lines, 10 cm. ($3^{15}/_{16}$") on Category III.

Sleepers to be replaced are decided each year by close examination and by sounding those which appear doubtful, and these are replaced experimentally one or two months before level inspection, so as to have a suitable bed.

Experimental replacements destroy track level; therefore, the S.N.C.F. limits them to renewals, which cannot await complete track renewal.

II. Metal and concrete sleepers.

Maintenance operations are generally confined to a periodical tightening of the fittings and replacement of those

items which no longer give the required solidity.

We have seen in Chapters III and IV of Part I the repairs, which it would be possible to effect to the sleepers themselves, we will recall only that these repairs cannot be done in the track, and consequently necessitate the removal and replacement of the sleepers to be repaired.

However with the Orion type reinforced concrete sleepers, it is possible to replace the wooden newels in which the coachscrews are fitted, but this operation, which must be done every 10 to 15 years necessitates the removal and return of the sleepers, which is a great disadvantage.

The type of fitting considered by the S.N.C.F. for future use, described in Chapter IV, 3, 5, Part I, has not this drawback.

Part 3.

FINANCIAL COMPARISONS.

The Railways supplied information concerning the cost of sleepers (cost price of the sleepers alone, cost of impregnation, of manufacture, of laying them, and finally the cost of maintaining the level), but it is difficult to compare the details given. The differences, often very considerable, between economic conditions on the one hand and the financial and even the political situation in different countries make any comparison between the cost of sleepers in different countries illusory, and consequently useless for the object we have in view. If such a comparison is to have any real value, the true value of the currency of each country would have to be taken into account together with the above considerations, and such an investigation is outside the scope of the present report.

We have merely converted the figures supplied by the different Railways for 1946 into a single currency, the French franc, to give them a more homogenous appearance. The economic data thus prepared are given in Appendix III. The rate of exchange on which these calculations were based were those applying on the French Exchange on the 1st February 1947, these being also given in the same appendix.

We will point out certain interesting points and draw a few conclusions from these tables, comparing the relative value of the figures relating to each country.

1. *Comparison of the cost price of wood sleepers made of different kinds of wood.*

As a general rule rough sleepers made of hardwood are dearer to buy than those made of soft wood, the price of oak and beech being approximately the same. The cost of impregnation however may have an appreciable effect on the total cost : it costs more to treat beech (often 2 or 3 times as much) as this absorbs a larger amount of the antiseptic, whereas the use of metal salts on the other hand gives a slight saving. Unfortunately, as each Administration has generally chosen for each kind of wood the most suitable and economic treatment, taking the possibility of obtaining supplies into acount, the figures given do not make it possible to compare the relative cost of the different methods and different antiseptics applied to the same kind of wood.

However the cost of impregnation only represents a portion of the total cost of the sleepers (about 18 % in the case of oak and 25 % in the case of beech), and there is no point in comparing the figures unless these are related to the additional life thereby given to the sleeper, and this was not possible with the information available.

It would be interesting, both from the

financial and technical points of view, to carry out comparative investigations of the methods and above all of the antiseptic products used.

Calculating the cost price of sleepers per year for their average life is particulary interesting; this shows that :

— impregnated oak and beech sleepers cost very much the same, beech being slightly dearer (Austria, France, etc.) except in Jugoslavia where the life of oak is estimated to be 10 years (which seems too short to us) while that of beech is 20 years, which gives the latter a great advantage. It would be interesting to know if this great difference is due to the antiseptic treatment. (As we have seen in this country oak sleepers are usually laid without being treated).

Deal sleepers, which cost less to buy, always cost more per year, as their life is much shorter than that of hardwoods.

As it usually costs more to maintain deal sleepers than hardwood sleepers, the use of the latter is only economical in normal times when the cost price is extremely low, as in the Scandinavian countries where only softwoods are found in abundance and there are no hardwoods, so that the technique of maintenance and renewal has been adapted to make their use economical.

In most other countries however only the present shortage of wood due to the war justifies the use of softwood sleepers.

2. *Influence of the rail fastenings on the cost price of sleepers.*

On most railways it costs about one third more to lay the rails on bearing plates than to lay them directly on the sleepers. Certain railways give an extremely high cost for such bearing plates, amounting to 2 to 3 times as much as the cost of the sleeper itself : Italy, Austria, Jugoslavia. This is due no doubt partly to the state of the steel industry in these countries which makes it necessary for them to import the bearing plates, and partly to the complexity of the fastenings used, which have already been described.

It would have been interesting to investigate to what extent the increase in the cost price, sometimes considerable, due to the use of bearing plates, is justified economically. No Administration, however, appears to have made any distinction between the life of sleepers with and without bearing plates, so that the economic value of such bearing plates cannot be estimated. Naturally the use of bearing plates has certain technical advantages, which may lead to savings as regards the maintenance of the fastenings and chairs, particularly on heavily loaded lines, but we should have liked to have seen the theoretical advantage of better distribution of the load on the wood translated by a longer life of the sleeper. In the absence of such information, it may be questioned whether the axle loads currently allowed on most railways justify the use of bearing plates, especially in those countries where they cost so much.

This point might form the subject of further investigations during which the railways could compare the information they were able to collect regarding economies in maintenance and special technical advantages, also in terms of economies, with the first cost.

3. *Financial comparison of the methods of maintaining the level.*

The information supplied makes it hard to compare the three different maintenance methods, tamping by hand, mechanical tamping, and measured shovel packing, for each kind of sleep-

er, as not many railways use all these methods at the same time with different kinds of sleepers.

The following remarks may be made however :

Tamping by hand is generally more costly than mechanical tamping, though not very much so, the greatest difference being reported by Czechoslovakia where hand tamping costs 2/3rds more than mechanical tamping. There is one exception to the above however : the Italian State Railways report that mechanical tamping costs slightly more (about 20 %), which may perhaps be explained by the low cost of the unskilled labour employed for hand tamping.

Measured packing is definitely the cheapest method of maintenance, especially when it is remembered that this method is the least harmful to the sleepers and can be used with all kinds of sleepers (wood, steel, concrete).

In France, on the French National Railways, who have used measured shovel packing for many years and are now thoroughly conversant with this method, it costs about half as much as mechanical tamping, and the advantage is still greater compared with hand tamping with its high labour costs.

Most railways using wood, steel and concrete sleepers state that the cost of maintaining the level is higher in the case of the last named, whatever method be used.

The French National Railways, on the contrary, find that both shovel packing and tamping cost less for metal sleepers and still less for concrete sleepers. This is due to the fact that the French National Railways consider the most important part of the work of maintaining the level is the removal and replacement of the top layer of ballast; the quantity of such ballast used with metal sleepers is less than with wood sleepers, and still less with concrete sleepers, which are often laid with practically none.

4. Financial comparison between wood, metal and reinforced concrete sleepers.

Before placing orders for large quantities of reinforced concrete sleepers (of the Vagneux type) and prestressed concrete sleepers, being driven thereto by force of circumstances, i.e. to make good the shortage of wood sleepers which are normally used on the French railways and cost less to buy, the French National Railways wished to get an idea of the cost involved in so doing, compared with using wood sleepers.

We thought it interesting to give the essential points of these calculations from which general conclusions can be drawn, which can also be applied to metal sleepers in the case of those railways who gave prices for sleepers other than wood sleepers.

A comparison was made, under the heading of the capital invested, of the financial charges due to the use :

1) on main lines (Categories I or II) ;

a) of ordinary or prestressed reinforced concrete sleepers;

b) sleepers made of creosoted home-produced oak with bearing plates.

2) on service sidings (Category IV) with heavy traffic (shunting or locomotive sidings for example) :

a) of ordinary or prestressed reinforced concrete sleepers;

b) sleepers made of pine from the Landes injected with copper sulphate by the Bethell process.

The bases of calculation are as follows : interest 5 %, stable currency and price.

	Reinforced or prestressed concrete.	*Hardwood creosoted with bearing plates.*	*Softwood injected with sulphate of copper with coachscrews.*
Maximum cost price with fastenings . . .	900	558	312
Cost of laying for the first time on a main line (to replace a wood sleeper)	116.4	78	...
Cost of laying on main lines when replacing similar sleepers	138.6	78	...
Cost of laying for the first time on sidings (to replace a wood sleeper)	110	...	70
Cost when laid during subsequent renewals replacing similar sleepers on sidings . .	132	...	70
Value of sleeper when scrapped	None.	100	12
Average or estimated life	45 years.	24 years.	10 years.

The results are as follows :

1) Comparison in the case of main lines (Categories I and II).

The calculations show that the capital that has to be invested for the initial replacement of a wood sleeper by a concrete sleeper, and the subsequent renewal of the latter every 45 years is 1 146 fr.

The use of concrete however results in the following savings :

a) reduction by one half in the amount of ballast needed, i.e. 0.25 m^3 (8.828 cu. ft.) per sleeper when the initial replacement is made, and when the ballast is renewed, say every 25 years. The corresponding reduction in capital can be taken as : 137 fr.

b) increase in the efficiency of the maintenance of level by measured shovel packing owing to the reduced amount of ballast needed. Corresponding reduction in capital is : 64 fr.

Therefore in the case of concrete the total capital investment is 1 146 — (137 + 64) = 945 fr.

In the case of wood sleepers with bearing plates, renewed every 24 years, the capital to be invested is 780 fr. per sleeper.

To this must be added the capital value of the special maintenance required with wood sleepers (tightening up the fastenings, re-adzing, binding the ends of sleepers after 12 years) estimated to be 192 fr.

The capital required in the case of a wood sleeper is therefore 780 + 192 = 972 fr. i.e. a little higher but not very much than concrete.

2) Comparison in the case of sidings (Category IV) between concrete and deal sleepers renewed every 10 years.

In this case the figures are :

— for concrete : 1 139 fr. (no savings from using less ballast).

— for deal : 1 262 fr. (the fastenings have to be gone over every 5 years).

The use of concrete sleepers seems to be definitely more economical on the whole.

Calculations on the same lines show that with an estimated life of 40 or 45 years, metal sleepers, the cost price of which in France is about the same as that of concrete sleepers, are about the same as wood sleepers from the financial point of view.

These conclusions naturally are only valid if the hypothesis adopted, especially as regards the estimated life of concrete sleepers, is verified in actual fact. The reinforced or prestressed concrete sleepers must be well designed and manufactured to last 45 years.

The interest of such calculations is the indication given of the conditions under which it is economically more advantageous to use concrete sleepers, and the resulting decision on the policy to be adopted : from what we have seen in France concrete sleepers should first of all be used on lines with relatively slow light traffic, where the mechanical stresses are small, where the full benefit of the long life of concrete or metal and the savings in maintenance due to their use can be counted on, compared with wood the usefulness of which is normally ended by rot. This is the case in particular with shunting lines and lines in Category III; the French National Railways have long recognised the undoubted advantage of metal sleepers in such cases, where they will last a very long time and require less maintenance.

Hardwood sleepers can therefore be reserved exclusively for renewals on lines with heavy, fast traffic, though this does not prevent trials of prestressed concrete sleepers being made on such lines.

The above calculations do not take into account certain advantages and drawbacks, to which no actual values can be given, as follows :

Concrete sleepers are very heavy, and consequently there are certain difficulties in laying them, special equipment being needed; on the other hand track laid in this way is extremely stable and subsequent maintenance operations are limited to a small amount of shovel packing.

It is a well known fact that, especially in the case of track maintained by shovel packing, the quality of the work is the better if the bed has not to be disturbed periodically, owing to substitutions or replacing burnt sleepers for example. Such operations, which are more frequent with wood sleepers than with metal or concrete ones, involve a great deal of maintenance work and a high consumption of ballast for re-bedding or underpinning and shovel packing.

This advantage of using metal or concrete sleepers is particularly great in the case of lines when the renewal of the ballast only takes place at very long intervals, i.e. in Categories III and IV, so that such sleepers should be given the preference in these cases.

To get some idea of the financial advantages of using each type of sleeper on certain railways, by making an investigation on the above lines, we give below a table of the cost of the different kinds of sleepers. Their relative value and length of life on each railway may be compared with the value and life of the different types of French sleepers on which the calculations were based.

Thus, apart from any technical considerations which may justify the choice of a type of sleeper which is not the most advantageous from the financial point of view, we find that certain types are definitely better than wood for certain railways.

This is the case in particular :

— in Belgium, metal sleepers;

Railway.	Remarks.	Hard wood.		Soft wood.		Steel.		Concrete.	
		Cost.	Estimated life.	Cost.	Estimated life.	Cost.	Estimated life.	Cost.	Estimated life.
French National Rys. (1947 prices) . .	With bearing plates.	558	24	378	12	864	40	800 to 900	45
	Direct fastening with coachscrews.	484	24	312	10				
Austria (1946) . .	...	25.4	20	18.5	12	48.6	30		
Belgium (1946) . .	...	322	20	...	...	341	45		
Algeria (1946) . .	...	606	15	414	10	657	35	691	30
Indo-China (1939) .	...	13	10	...	...	10.6	25	6.25	20
Tunisia (1946) . .	Sleeper only.	260	15	220	10	738	45	256	20
Italian State Railways (1946) . . .	...	1 900	15	...	...	3 600	40		
Poland (1939) . . .	...	...	...	14.5	15	35	20		
Switzerland (1946) .	...	39	20	...	...	44.8	32		
Czechoslovakia (1946)	...	342	15	262	8	464.7	25		
Jugoslavia	Beech.	269	22	...	...	...	...	440	35
	Oak.	...	...	228	10				

— in Algeria, steel or concrete sleepers;

— in Indochina, concrete sleepers, and to a lesser extent, steel sleepers;

— in Tunisia, concrete sleepers;

— in Switzerland, steel sleepers.

However the use of concrete or steel sleepers on certain railways although they are dearer to buy than wood, but cheaper in the long run owing to their long life and savings in maintenance, means a capital investment the results of which are only seen after long years. It is possible that for certain railways, who have already had to meet considerable expense owing to the war and the resulting destruction, such a policy will mean a heavy financial burden, which may even be greater than they can tackle with the funds at their disposal.

The policy adopted therefore in chosing the type of sleeper to be used in the coming years is often a compromise taking all these factors into account. Other factors also may intervene :

— in the case of concrete sleepers, the difficulty of equipping plant to manufacture them in large quantities and a shortage of cement;

— in the case of metal sleepers, insufficient production capacity of the steelworks in most countries.

It would seem that the railways must definitely adopt a policy of compromise in obtaining their sleepers, in spite of technical preferences and financial advantages.

* * *

SUMMARY AND CONCLUSIONS.

We thought it advisable to summarise in a few words the more important facts collected together in this report :

1) It is obvious that wood sleepers are still considered to be the most satisfactory on most railways. They are easy to maintain in service and at the present time are the only ones with which sufficiently good insulation of the rails can be obtained.

2) We think it advisable to draw attention to the problem of impregnating the wood.

After the great shortage due to the war in all European countries, creosote has come on the market again to some extent, but this may only be a temporary relief; it is therefore interesting to continue the researches into products and processes to replace it, some of which seem to be very promising.

3) The problem of fastening flat-bottomed rails on wood sleepers has been solved for some time in the ways described in the report, which are rather complicated and costly. It would be interesting to collect together the opinions and results obtained in this connection (which we were not able to do) to get an exact idea of the value of these solutions.

4) Metal sleepers have given satisfaction to the railways using them, so long as the fastenings are kept in good repair, but their use is likely to remain restricted owing to the shortage of steel, which can be better used for other purposes, as well as the difficulties of using them with track circuits.

5) Concrete sleepers do not appear to have given much satisfaction. The railways have not been very enthusiastic about the results obtained; some of them have even found it better to say nothing about the tests being made. Undoubtedly, their use so far has not given any definitive results, but it is also certain that the possibilities of concrete, especially prestressed concrete, have not been exhausted. Trials of the latter kind so far have only been made on a small scale and the railways have not supplied any information on the observations made and the expected results.

6) The problem of fastening the rail on reinforced concrete sleepers has not yet been solved. Most of the methods used to date have been unsatisfactory. The more recent have not yet been confirmed by sufficiently long experience. This is however a very important problem; any effective solution will make possible a great development in the use of concrete on the permanent way.

7) Fastenings and elastic bearing plates are being improved. When used together, especially in the case of concrete sleepers, they seem to be a definite improvement, especially in obtaining better fixing of the rail to prevent creep and undue stresses.

8) Longitudinal supports for the rails have not been tried out to any great extent. When used, there would not appear to be any serious interest in using wood or metal, whereas the use of concrete would appear to open out new fields. Better distribution of the loads would soon reduce maintenance of the level to negligeable limits; the track would be heavier, less likely to warp vertically, while the practically continuous rail fastenings would make it easy to maintain it under stress; all these advantages would result from the use of concrete longitudinals, all of which would be of great value in solving the problem of making a jointless permanent way.

Consequently investigating the general problem of the sleeper leads to many special investigations of undeniable interest, about which the railways should exchange ideas as and when concrete results are obtained.

These are the conclusions which in our opinion result from studying the problem of the sleeper.

* * *

APPENDIX I.

Classes of railway concerned.

Table VIII hereafter gives the total length in single track of the railways systems covered by this report classified into four categories :

Category I — lines where the effective maximum speed is greater than 95 km. (59 miles) /h, or run over by trains of at least 1 000 tonnes (984 Engl. tons).

Category II — lines where the effective maximum speed lies between 60 and 95 km. (37 and 59 miles) /h, or run over by trains of more than 500 (492 Engl. tons) but less than 1 000 tonnes.

Category III — lines other than those in Categories I and II.

Category IV — Sidings, i.e. lines in stations which are not used by traffic from one station to another or from an important shed or shop to the station.

* * *

APPENDIX II.

Maximum axle-load of locomotives and wagons.

Table No. IX hereafter gives, for each category of line, the maximum axle-load P of locomotives, carriages and wagons and the maximum distance D between two wheel centres when the two neighbouring axles are heavily loaded.

The most interesting figures in the table are those under Category I, which show the maximum permissible load on the whole of the lines of each system. This is at present 24 t. (23.620 Engl. t.) for axles 2.05 m. ($6'6^{25}/_{32}''$) apart, in Belgium. Most Administrations allow axle-loads equal to or more than 18 t. (17.715 Engl. t.) and at this weight the distance between two neighbouring loaded axles is reduced to 1.50 m. ($4'11^{1}/_{16}''$) (Finland) and even to 1.30 m. ($4'3^{3}/_{16}''$) (Swedish State), the maximum being 2.50 m. ($8'2^{7}/_{16}''$) (Italy).

For carriages and wagons the axle-load varies between 15 and 20 t. (14.763 to 19.684 Engl. t.).

As for the figures shown for Categories II and III (1) the axle-loads allowed on the different lines are calculated from the factors relating to the permanent way and works, apart from the imposition of any speed limit.

The classification of lines by axle-load would give a result quite different from that which we have adopted; it is not surprising, therefore, that some Administrations should have shown for lines of Categories II and III the same axle-load and spacing as for Category I lines, which does not necessarily signify that all vehicles (locomotives and wagons) conforming to these requirements are allowed to run over all Categories II and III lines.

The Danish Railways explain in this respect that the axle-load for lines is a function of the weight of rail used on the track; 20 t. for 45 kgr. (100 lbs.) rails, 18 t. for 37 kgr. (82 lbs.) rails with sleepers spaced at 65 cm. ($2'1^{5}/_{8}''$) intervals, 16 t. (15.747 Engl. t.) for 37 kgr. rails with sleepers spaced at 80 cm. ($2'7\frac{1}{2}''$) intervals, 13 t. (12.794 Engl. t.) for 32 kgr. (70 lbs.) rails, 11 t. (10.826 Engl. t.) for 22.5 kgr. (50 lbs.) rails.

In the same respect, the Finnish Railways report that they allow 17 t. (16.731 Engl. t.) axe-loads at 100 km. (62 miles)/h. on Category I lines, limiting only 18 t. axle-loads to 60 km. (37 miles) /h. whilst on Category II lines the maximum axle-loads are, as in Denmark, directly related to the weight of rail used in the track.

The French National Railways allow a minimum axle-load of 17 t. for the three categories, and for calculating the maximum axle-load, lines are classified in five categories, according to the strength of the track, reckoned by the formula $\frac{I}{\frac{n}{l}}$ (I = moment

(1) Class IV has not been included. This class includes stabling roads and these are available for all trains running on principal lines, whatever their category. Attention is called to the fact that the classification into 4 categories adopted here is based solely on the speed and weight of trains.

of inertia of the rail, having regard to the amount of wear, by comparison with the neutral horizontal axis; n = characteristic of the neutral section furthest from the same neutral axis; l = greatest distance between the centres of sleepers).

Locomotives are then characterised by their « co-efficient of security » K. $\frac{P.L^2V^2}{E}$ which allows the determination of their maximum theoretical speed V on those lines over which their axle-load p permits them to run.

P = total weight of the locomotive in tons.

L = total length of the locomotive in metres.

V = maximum speed of the locomotive in km./h.

E = total wheelbase in metres.

K = coefficient 0.5 to 0.6 with bogies, 0.7 to 0.8 with bissel truck, 1 without bogie or bissel.

The conditions in which a locomotive of maximum axle-load p is allowed to run at a speed V are defined in the following table :

Track. Weight.	$\frac{I}{\frac{n}{l}}$ mm^2	*Group no. of track and loco.*	*Locomotives allowed to circulate.*	
			p (tons).	$\frac{K.P.L^2V^2}{E}$ *maximum.*
Very light	100-140	1	17	3 500
Light	141-180	2	18	5 500
Medium	181-235	3	20	9 300
Heavy	236-350	4	21.6	15 500
Very heavy	$\geqslant$ 351	5	23	To be decided when corresponding engines are built.

APPENDIX III.

Financial comparaison.

Tables X to XV hereafter sum up the financial data supplied by the different railways.

The 1946 prices have been changed into French francs according to the rates of exchange given below, as given by the French Exchange on the 1st February 1947 :

		French fr.
Austria	1 schilling	12
Belgium	1 Belgian franc	2.70
Denmark	1 Danish crown	24.50
Finland	1 Finnish mark	0.88
Indo-China	1 Indochinese piaster	17
Holland	1 florin	45
Italy	1 lire	0.53
Norway	1 Norwegian crown	24.04
Poland	1 zloty	1.193
Portugal	1 escudo	4.83
Sweden	1 Swedish crown	33.19
Switzerland	1 Swiss franc	27.50
Czechoslovakia	1 Czech crown	2.386
Jugoslavia	1 dinar	2.386

TABLE VIII.

Length of single track on the different railways

(in km).

	Category I.		*Category II.*		*Category III.*		*Category IV.*		*Remarks.*
	V.N.	*V.E.*	*V.N.*	*V.E.*	*V.N.*	*V.E.*	*V.N.*	*V.E.*	
Austria	1 140	...	3 810	...	2 072	518	2 910	90	V.E. : 0.760 m.
Belgium :									
S.N.C.B.	4 220	...	2 716	...	786	...	5 436		
Matadi-Léopoldville . .	...	...	...	...	...	365	...	100	V.E. : 1.067 m.
Lower-Congo-Katanga . .	...	...	...	...	...	2 515	...	321	V.E. : 1.067 m.
Denmark :									
Danish State Railways .	1 700	...	1 120	...	250	...	1 470		
South Funen Railway .	...	...	103	...	115	...	51		
Finland	645	...	3 973	...	294	...	1 700	...	Gauge : 1 524 mm.
						208	...	...	Gauge : 750 mm.
						41	...	...	Gauge : 600 mm.
France :									
S.N.C.F.	31 098	...	17 487	...	12 760	...	20 457		
Somain-Anzin	76	...	53	...	...	...	347		
Société Générale des Chemins de fer Economiques.	...	...	327	...	1 061	1 946	350	...	V.E. : 1.000 m.
Chemins de fer Economiques du Nord	...	...	...	...	...	54	...	6	V.E. : 1.000 m.
Chemins de fer Vicinaux.	...	...	...	...	...	131	...	7	V.E. : 1.000 m.
Paris Metropolitan . .	...	...	42	...	373	...	61		

Holland	1 900	...	2 100	...	650	...	1 750		
Italy :									
Italian State Railways .	9 650	...	890	...	10 746	...	8 290	595	V.E. : 0.980 m.
North Milan	...	...	230	...	89	...	99		
Luxembury	76	...	208	...	337	155	216	11	V.E. : 1.000 m.
Norway	...	...	3 900	...	115	178	930	...	V.E. : 1.067 m.
Poland	17 100	...	8 700	...	4 200	...	10 300		
Portugal :									
Portuguese Railways . .	...	645	...	1 944	...	...	...	486	V.L. : 1.668 m.
North Portugal	...	...	...	...	...	178	...	18	V.E. : 1.000 m.
Rumania	4 000	...	6 347	...	...	726	3 796	...	V.E. : 0.760 m.
Sweden :									
Swedish State Railways .	4 583	...	6 514	...	1 238	5	4 476	18	V.E. : 1.067 m.
						7	...	25	V.E. : 0.831 m.
Stockholm-Roslagen . .	...	...	...	247	...	92	...	59	V.E. : 0.891 m.
Norsholm-Västervik . .	...	...	...	...	...	202	...	32	V.E. : 0.891 m.
Nora-Bergslag	...	...	...	...	173	...	48		
Grängesberg-Oxelösund .	257	...	46	...	...	...	202		
Göteborg-Dalarne-Gävle .	571	...	663	...	92	...	469		
Västergötland-Göteborg .	...	...	...	240	...	...	...	50	V.E. : 0.891 m.
Switzerland :									
Swiss Federal Railways .	2 971	...	971	...	...	...	2 033		
Rhaetian Railways . . .	...	...	...	...	...	276	...	66	V.E. : 1.000 m.
Czechoslorakia	4 170	...	4 358	...	4 134	66	5 461	28	V.E. : 1.000 m.
						190	...	11	V.E. : 0.760 m.
						9	...	0	V.E. : 0.750 m.
Turkey	...	...	...	...	7 243	...	726		
Jugoslavia	1 650	...	3 676	393	2 650	1 602	2 184	459	V.E. : 0.760 m.

Note : V.L. = Large gauge.
V.E. = Narrow gauge.

TABLE IX.

Maximum axle loads { locomotives / wagons } and minimum wheel base.

	Category I.			*Category II.*			*Category III.*		
	Locomotives.		*Wagons.*	*Locomotives.*		*Wagons.*	*Locomotives.*		*Wagons.*
	W.	D.	W.	W.	D.	W.	W.	D.	W.
	t.	*m.*	*t.*	*t.*	*m.*	*t.*	*t.*	*m.*	*t.*
Austria : V.N.	18	...	20	16	...	20	12.5	...	16
V.E.	...	...	...	...	...	...	8.5		
Belgium :	24	2.050	20						
Matadi-Léopoldville	...	...	...	...	...	...	15	...	13
Lower-Congo-Katanga	...	...	...	...	...	...	15	...	15
Denmark :									
Danish State Railways	20	...	20						
South Funen Railway	...	...	...	11	...	12			
Finland	18	1.500	12.75	14	1.50	12.75			
France :									
S.N.C.F.	22	2.050	20						
Somain-Anzin	20.200	1.350	16	20.200	1.350	16	16.700	...	16
Société Générale des chemins de fer Economiques V.N.	...	...	...	17	2.10	16			
V.E.	...	...	...	10.6	1.40	8			
Chemins de fer Economiques du Nord	...	...	...	...	...	...	8	2	8
Chemins de fer Vicinaux	...	...	...	...	...	...	7.650	1.600	7.500
Paris Metropolitan	...	...	...	20	2.20	20	15	1.50	15
Algeria	20	1.725	18	18.5	1.700	18	12	1.250	12
Indo-China	...	...	...	12.5	...	10			
Damas-Hama V.N.	...	...	...	...	...	...	14.600	1.420	14.500

Holland									
Italy :									
Italian State Railway	20	2.50	16	16.5	...	16	16	...	16
North Milan	...	...	...	16.5	1.850	...	16.5	1.850	...
Luxemburg { V.N.	22.5	2.050	15	18.7	1.650	15	18.7	1.650	15
Luxemburg { V.E.	...	...	...	...	...	...	11	1.350	8
Norway { V.N.	...	...	...	18	...	...	14		
Norway { V.E.	...	...	...	...	...	...	7		
Poland	18	1.530	15	15.5	1.530	15	14	1.530	15
Portugal :									
Portuguese Railways	17.6	...	15						
North Portugal	...	...	...	...	...	...	11	...	11.500
Rumania	20	...	...	16					
Sweden :									
Swedish State Railways . . .	18	1.300							
Stockholm-Roslagen	...	...	...	9.350	1.250	12			
Norsholm-Västervik	...	...	...	...	...	...	3.550	...	4.250
Nora-Bergslag	...	...	...	...	...	...	14.500	...	17.400
Grängesberg-Oxelösund . . .	19	...	18						
Göteborg-Dalarne-Gävle . . .	18.3	...	18.7	12.5	...	14.450	12.5	...	14.450
Västergötland-Göteborg . . .	...	...	...	7.2	...	10			
Switzerland :									
Swiss Federal Railways . . .	20	1.750	20	20	1.750	20			
Rhaetian Railways	...	...	...	...	...	...	11	1.200	7.380
Czechoslovakia	18.8	1.630	20	16	1.930	18	14.5	1.400	16
Turkey	...	...	...	...	...	...	18.5	...	20
Jugoslavia { V.N.	20	1.500	15	16	1.500	15	13	1.200	15
Jugoslavia { V.E.	...	...	...	9	1	7	9	1	7

V.E. = Narrow gauge.
Note : V.N. = Standard gauge.

Cost price of wood s

Note: The average cost price, per sleeper and per year, is s

			Cost of sleepers ready for laying.		*Cost of layi*	
			1946	*1939*	*1946*	*1*
Austria	Sleeper only.	Oak.	12.9	8.6	...	
		Beech.	12.9	8.6	...	
		Larch.	9	6	...	
		Deal.	8.1	5.4	...	
	With chair.	Oak.	28.5	19	4.6	
		Beech.	28.5	19	4.6	
		Larch.	24.8	16.5	4.6	
		Deal.	24.0	15.9	4.6	
	With bearing plates.	Oak.	25.4	16.6	4.6	
		Beech.	25.4	16.6	4.6	
		Larch.	20.7	13.8	4.6	
		Deal.	18.5	12.3	4.6	
Belgium : S.N.C.B.	Sleeper only.	Oak, beech.	232	50	...	
		Fir.	201			
	With bearing plates.	Oak, beech.	322	118	45	1
Denmark	Sleeper only.	Beech.	20.48	10.58		
	With bearing plates.	Fir.	...	...	...	
South Funen	Sleeper only.	Fir.	14.50	7	...	
	With bearing plates.	Fir.	19.30	9.40	5.00	
Finland	Sleeper only.	Deal.	275	45	...	
France :						
S.N.C.F.	Sleeper only.	Hardwood.	440	55	...	
		Softwood.	275	34	...	
	With chair.	Hardwood.	962	159	60	
		Softwood.	797	138	60	
	With bearing plates.	Hardwood.	558	76	60	
		Softwood.	378	71	60	
Somain-Anzin	Sleeper only.	Oak.	373	75	...	
		Beech.	425	...	...	
Metro	Sleeper only.	Oak.	322	60	...	
Algeria	Sleeper only.	French oak.	450	72	...	
		Deal.	258	...	...	
		Colonial woods.	280	...	...	
		Algerian oak.	270	45	...	
	With bearing plates.	French oak.	606	94	...	
		Deal.	414	...	...	
		Colonial woods.	436	...	...	
		Algerian oak.	426	67	...	

line in Categories I & II.

French francs and the currency of the country concerned.

Total cost.		*Life.*	*Average annual cost.*			*Re-use.*
46	*1939*	*Years.*	*1946* (Fr.)	*1946* (N.C.)	*1939*	
...	...	20	7.74	0.645	0.432	40 % — 10 years.
...	...	18	8.59	0.716	0.475	40 % — 10 years.
...	...	15	7.20	0.6	0.4	30 % — 5 years.
...	...	12	8.10	0.675	0.45	30 % — 5 years.
3.1	21.5	20	19.92	1.66	1.08	
3.1	21.5	18	22.08	1.84	1.19	
9.4	19	15	23.52	1.96	1.27	
8.6	18.4	12	28.56	2.38	1.53	
0	19.1	20	18	1.5	0.96	
0	19.1	18	20.04	1.67	1.06	
5.3	16.3	15	20.28	1.69	1.27	
3.1	14.8	12	23.16	1.93	1.53	
...	...	20	31.32	11.6	2.8	70 % — 20 years.
7	136	20	35.10	13.00	5.5	
27.10	11.50					
...	...	30	11.76	0.48	0.23	
24.30	11.90	30	19.84	0.81	0.40	
...	...	12.5	19.36	22	3.6	
...	...	24	18.33	...	2.29	75 % — 20 years.
...	...	12	22.91	...	2.83	
22	167	24	42.58	...	6.95	
57	146	12	71.41	...	12.16	
46	84	24	25.66	...	3.5	
38	79	12	36.5	...	6.58	
...	...	20	18.56	...	3.75	60 % — 3 years.
...	...	20	21.55	...	...	75 % — 12 years.
...	...	15	21.46	...	4	70 % — 15 years.
...	...	15	30	...	4.8	20 % — 7 years.
...	...	to be determined				
...	...	»				
...	...	»				
...	...	15	40.4	...	6.27	
...	...	to be determined				
...	...	»				
...	...	»				

Cost price of wood s

Note: The average cost price, per sleeper and per year, is g

			Cost of sleepers ready for laying.		*Cost of layin*	
			1946	*1939*	*1946*	*19*
Indochina	Sleeper only.	...	40	13	...	
Tunisia	Sleeper only.	Oak.	220	30	...	
			260	...	...	
Holland	Sleeper only.	Oak.	20.7	6.79	...	
	With bearing plates.	Oak.	27.74	9.29	1.20	
		Deal.	21.74	8.99	1.20	
Italy :						
Italian State Railways	Sleeper only.	Oak.	660	25	...	
	With bearing plates.	Oak.	1 900	86	85	
North Milan	Sleeper only.	Oak.	860	28	...	
Norway	Sleeper only.	Deal.	18.2	8.7	...	
Poland	Sleeper only.	Deal.	300	8	...	
	With chair.	Deal.	414	19	30	
	With bearing plates.	Deal.	383.5	14.5	30	
Portugal	Sleeper only.	Deal.	24.86	7.76	...	
Sweden	Sleeper only.	Deal.	10	4.5	...	
	With bearing plates.	Deal.	16.5	8	2	
Switzerland	Sleeper only.	Hardwood.	34.5	13.85	...	
	Direct fastening.	Hardwood.	39	15.15	2.8	
	With bearing plates.	Hardwood.	52.4	18.75	3	
Czechoslovakia	Sleeper only.	Oak.	271.79	69.67	...	
		Beech.	237.03	63.23	...	
		Larch.	192.20	56.59	...	
		Deal.	178.42	54.03	...	
	With bearing plates.	Oak.	342.22	101.84	13	
		Beech.	307.49	95.40	13	
		Larch.	262.63	88.76	13	
		Deal.	248.85	86.20	13	
Jugoslavia	Sleeper only.	Oak.	228	57	...	
		Beech.	269	87	...	
	With bearing plates.	Oak.	513	146	35	
		Beech.	839	264	35	

Continued.)

on line in Categories I & II.

French francs and the currency of the country concerned.

Total cost.		*Life.*	*Average annual cost.*			*Re-use.*
946	*1939*	*Years.*	*1946* (Fr.)	*1946* (N.C.)	*1939*	
...	...	10	68	4	1.3	10 % — 5 years.
...	...	10	22	...	3	20 % — 5 years.
...	...	15	17.33			
...	...	28	33.25	0.739	0.242	30 % — 7 years.
28.94	9.86	28	46.35	1.03	0.35	
22.94	9.56	23	45	1.00	0.42	
...	...	15	.23.32	44	1.66	
85	89	15	70.13	132.33	5.93	
...	...	10	45.58	86		
...	...	22	19.88	0.827	3.95	
...	...	15	23.86	20	0.53	
44	20	15	35.31	29.6	1.33	
13.5	15.5	15	32.56	27.3	1.03	
...	...	14	2.57	1.775		
...	...	10	33.19	1	0.45	
18.5	9.25	20	30.70	0.925	0.46	
...	...	20	47.3	1.72	0.69	25 % — 15 years.
41.8	16.75	20	57.75	2.10	0.85	
55.4	20.45	20	75.62	2.75	1.05	
...	...	15	43.21	18.11	4.64	
...	...	12	47.99	19.74	5.26	
...	...	10	45.86	19.22	5.66	
...	...	8	53.21	22.30	6.75	
55.22	105.84	15	56.50	23.68	7.06	
20.49	99.40	12	63.73	26.71	8.28	
75.63	92.76	10	65.66	27.52	9.28	
61.85	90.20	8	78.09	32.73	11.27	
...	...	10	54.40	22.8	5.7	
...	...	22	29.10	12.2	3.9	
48	10.96	10	130.75	54.8	15.15	
74	19.48	22	94.72	39.7	12.30	

Cost of metal s

Note: The average cost price, per sleeper and per year,

		Cost of sleeper ready for laying on the permanent way.		*Cost of layin*	
		1946	*1939*	*1946*	*19*
Austria	Sleeper only.	33.20	25.50	...	
	With fastening by bearing plates.	43.5	33.5	5.1	
Belgium : S.N.C.B.	With fastening by bearing plates.	296	98	45	18
France :					
S.N.C.F.	Without fastening.	536	75	...	
	With chairs.	1 018	140	66	9
	With bearing plates.	798	110	66	9
Algeria	Without fastening.	610	100	...	
	With sleeper clips.	629	108	28	8
Indo-China	Without fastening.	44	10.5	0.4	0
Tunisia	Without fastening.	700	70	38	8
Italy: Italian State Rys.	With sleeper clips and bolts.	3 260	71	95	4
Poland	Without fastening.	...	28	...	
	With bearing plates.	...	34	...	1
Switzerland	Without fastening.	35.9	11.2	...	
	With direct fastening.	42.3	14.3	2.5	1
Czechoslovakia	Without fastening.	417.9	124	...	
	With direct fastening.	451.7	138.68	13	4

Cost price of concrete s

Note: The average cost price, per sleeper and per year,

		Cost of sleeper ready for laying in the track.		*Cost of layin*	
		1946	*1939*	*1946*	*19*
France :					
S.N.C.F.	BA — Without fixing.	620	65	...	
	With chairs.	1 102	163	76	1
	With fastenings.	782	97	76	1
	BA prestressed without fastenings.	636			
	With fastenings.	867	...	76	
Algeria	Vagneux — without fixing.	460	59	...	
	With fastenings.	656	86	35	1
Indochina	Orion VE — without fixing.	...	5.75	...	
Tunisia	Vagneux — without fixing.	225	...	31	
Jugoslavia	Tie-beams without fixing.	368	...	72	

n Category I & II lines.

in French francs (FF) and in the national currency (NC).

Total cost.		*Life.*	*Average annual cost.*			*Re-use.*
1946	*1939*		*1946* FF	*1946* NC	*1939*	
...	...	30	13.20	1.10	0.85	
48.6	36.5	30	19.44	1.62	1.22	50 %.
41	116	45	20.52	7.6	4.6	
...	...	40	13.4	...	1.87	80 % — 20 years.
84	149	40	27.1	...	3.7	
64	119	40	21.6	...	2.1	
...	...	35	17.43	...	2.84	5 % — 15 years.
57	111	35	18.80	...	3.17	
44.4	10.6	25	30.19	1.776	0.424	
38	78	45	16.4	...	1.75	
00	78	40	47.7	90	1.95	
...	...	20	...	...	1.4	
...	35	20	...	...	1.75	
...	...	32	30.8	1.12	0.35	
44.8	15.7	32	38.5	1.4	0.5	80 % — 20 years.
...	...	25	39.87	16.71	4.96	
464.7	142.68	25	44.35	18.59	5.71	75 % — 15 years.

on Category I & II lines.

46 in French francs (FF) and in the national currency (NC).

Total cost.		*Life.*	*Average annual cost.*			
1946	*1939*		*1946* FF	*1946* NC	*1939*	
...	...	40	15.5	...	1.62	
1 178	173	40	29.3	...	4.3	
858	107	40	21.4	...	2.6	
943	...	45	19.52			
...	...	30	15.3	...	1.97	
691	96	30	23.03	...	3.2	
...	6.25	20	...	...	0.31	Indochinese piastre.
256	...	20	12.8			
440	...	35	31.02	13		

TABLE XIII.

Cost of making wood sleepers.

	1946		*1939*	*Remarks.*
	N.C.	F.F.	N.C.	
Austria	0.50	6	0.35	
Belgium	6.675	18.02	1.451	
France :				
S.N.C.F.	...	15.20	2.10	
Somain-Anzin	...	8	2	
Chemins de fer Economiques du Nord	...	4.09	0.55	
Paris Metro.	...	13.70	3.57	
Algeria	...	12	2	
Tunisia	...	11.08	1.78	
Holland	0.24	10.80	0.12	Hardwood.
	0.20	9	0.10	Softwood.
Italy	18	9.54	0.94	
Portugal	0.75	3.62	0.75	
Czechoslovakia	3.7	8.83	2.1	

TABLE XIV.

Cost of different processes used in impregnating sleepers.

Note : The cost price in 1946 is given in French francs (FF) and national currency (NC).

	Kind of wood.	*Method of impregnation and quantity of antiseptic absorbed per sleeper.*	*Cost price per sleeper.*		
			1946		*1939*
			French francs.	*National currency.*	
Austria	Larch.	Combined method using creosote (3 kgr.) and zinc chloride (6 kgr.).	...	...	1.97
	Beech.	Double method using zinc chloride (20 kgr.) and creosote (12 kgr.).	...	...	5.50
	Oak.	Ruping with creosote (4 kgr.).	...	...	2.24
	Beech.	Double ruping with creosote (15 kgr.).	...	...	6.80
	Larch.	Ruping with creosote (5 kgr.).	...	...	2.50
	Deal.	Ruping with creosote (6 kgr.).	...	...	2.80
Belgium	Oak.	Ruping with creosote (3 kgr.).	22.41	8.30	3.78
	Beech.	Double ruping with creosote (13 to 15 kgr.).	61.88	22.92	13.81
	Fir.	Ruping with creosote (5 to 9 kgr.).	40.93	15.16	...
Denmark	Beech.	Double ruping with creosote (15.4 kgr.).	193.5	7.90	3.60
	Fir.	Ruping with creosote (6.8 kgr.).	91.1	3.72	1.74
Finland	Deal.	Ruping with creosote (6 to 7 kgr.)	...	...	13 to 17

TABLE XIV. *(Continued.)*

Cost of different processes used in impregnating sleepers.

Note : The cost price in 1946 is given in French francs (FF) and national currency (NC).

	Kind of wood.	*Method of impregnation and quantity of antiseptic absorbed per sleeper.*	*Cost price per sleeper.*		
			1946		*1939*
			French francs.	*National currency.*	
France :					
S.N.C.F.	Oak.	Ruping with creosote (4.5 kgr.).	24.25	...	3.84
	Beech.	Double ruping with creosote (16.5 kgr.).	41.25	...	7.04
	Deal.	Ruping with creosote (5.5 kgr.).	17.57	...	3.84
	Deal.	Bethell using copper sulphate (0.5 kgr.)	28	...	...
Somain-Anzin	Oak.	Ruping with creosote (4.5 kgr.).	68	...	16.35
	Beech.	Double ruping with creosote (16 kgr.).	128	...	...
Chemins de fer Economiques du Nord	Oak.	Heat immersion in creosote bath (2.5 kgr.).	31.2	...	3.12
Paris Metro	Oak.	Bethell using creosote (4.5 kgr.).	...	...	21
	Oak.	Ruping with creosote (2.4 kgr.).	80	...	...
Algeria	Oak.	Bethell using creosote (4 kgr.).	45	...	8
	Oak.	Immersion in creosote cold (3 kgr.).	45	...	8
	Oak.	Bethell with zinc chloride (8 kgr.).	35	...	...
Tunisia	Oak.	Immersion in creosote cold (2.150 kgr.).	32	...	...
Holland	Oak.	Ruping with creosote (5 kgr.).	67.5	1.50	0.75
	Deal.	Ruping with creosote (7 kgr.).	76.5	1.70	0.85
	Beech.	Double ruping with creosote (17 kgr.).	121.5	2.70	1.35
Italy: Italian State Rys.	Turkey oak.	Bethell using creosote (6 kgr.).	...	...	5.16
	Deal-elm.	Ruping with creosote (7 kgr.).	38.16	72	6.02
	Beech.	Double ruping with creosote (10 kgr.).	...	...	8.60
Norway	Deal.	Ruping with creosote (6 kgr.).	145.44	6.05	2.90
Poland	Deal.	Ruping with creosote (4.5 kgr.).	...	...	2
Portugal	Deal.	Bethell with creosote ((5.7 kgr.).	63.51	13.15	6.78
	Deal.	Bethell with zinc chloride (33.5 kgr.).	21.97	4.55	...
Czechoslovakia	Oak.	Ruping with creosote (4 kgr.).	74.68	31.3	14.1
	Beech.	Combined with creosote (13.5 kgr.) and zinc chloride (14 kgr.).	155.80	65.3	27.8
	Larch.	Ruping with creosote (4.5 kgr.).	74.20	31.1	...

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Cost of maint

Note: 1939 and 1946 costs given in national currency; the 1946 cost h

	Kind of sleeper.	*Measured shovel packing.*		
		1946		*1939*
		FF	NC	NC
Austria	Wood.	...	...	...
	Steel.	...	...	...
Belgium	Wood.	14 661	5 430	2 22
	Steel.	18 306	6 780	2 76
Denmark : South Funen	Wood.	...	...	...
Finland	Wood.	...	...	...
France :				
S.N.C.F.	Wood.	30 000	—	5 80
	Steel.	24 800	—	4 50
	Concrete.	20 400	—	3 60
Somain-Anzin	Wood.	32 000	—	6 40
Chemins de fer Economiques du Nord.	Wood.	...	...	...
Paris Metro.	Wood.	...	...	...
Indo-China	Wood.	...	...	...
	Iron.	...	...	...
	Concrete.	...	...	...
Togo	Iron.	...	...	...
Algeria	Wood.	...	...	...
	Iron.	...	...	...
	Concrete.	...	...	...
Tunisia	Wood.	14 000	—	2 60
	Iron.	...	...	...
	Concrete.	13 600	—	—
Holland	Wood.	12 735	283	18
Italy : Italian State Railways	Wood.	...	...	...
	Iron.	...	...	...
Norway	...	...	...	...
Poland	Wood crushed stone.	...	...	...
	Wood gravel	...	...	...
Switzerland	Steel.	...	...	...
Czechoslovakia	Wood.	...	26 130	8 04
	Steel.	...	...	...

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ven in French francs on the basis already indicated before.

Hand tamping.			*Mechanical tamping.*			*Remarks.*
1946		*1939*	*1946*		*1939*	
FF	NC	NC	FF	NC	NC	
800	1 150	700	9 600	800	500	
200	1 600	1 000	12 000	1 000	700	
655	7 650	3 060				
400	12 000	4 800				
500	1 000	500				
280	6 000	1 200				
000	—	13 300	62 200	—	10 500	
400	—	9 400				
300	—	10 800				
000	—	18 000				
655	—	617				
000	—	5 860				
100	300	150				
080	240	120				
080	240	120				
907	1 710	400				
500	—	3 000				
800	—	2 800				
200	—	2 600				
000	—	4 700				
000	—	3 900				
...	—					
890	442	290				
000	100 000	3 500	63 600	120 000	8 500	
300	110 000	3 800	68 900	130 000	9 000	
060	1 500	900				
548	2 136	1 496				
403	1 176	824				
375	5 250	3 300	134 750	4 900	3 025	
748	35 100	10 800	50 249	21 060	6 480	
359	42 900	13 200	61 415	28 740	7 920	

[385. (06 .119) & 385. (09 .3 (.494)

The International Railway Congress Association and the Centenary of the Swiss Railways.

(Note from the Swiss Executive Organising Committee for the Lucerne Congress).

The Swiss Railways are celebrating in 1947 the centenary of the creation of the first railway between Zurich and Baden. Various shows will be organised in connection with this event in the principal Swiss towns, one after the other.

They will be held in Lucerne during the Congress, and will include :

1. — *An exhibition of railway models,* This exhibition will include about 70 models of Swiss railway stock of different periods, built to a scale of 1/10th by the Swiss Federal Railways and Manufacturers, as well as models prepared by amateurs, and models of equipment, signal and interlocking installations. In particular, four complete trains will be included, built to a reduced scale, showing what trains were like in the years 1858, 1882, 1910 and 1945/46.

The exhibition will be held in the great hall of the Museum of Arts and Crafts at Lucerne, from the 18th June to the 2nd July 1947.

2. — *An exhibition « Youth and the Railways »,* consisting of some thousand drawings by children, classified into eight different groups.

This exhibition will be held in Lucerne, from the 19th June to the 1st July 1947.

3. — *An exhibition of railway literature,* consisting of a representative collection of books and works devoted to the subjects of the Swiss Railways from the earliest days to the present time.

This exhibition, organised by the Swiss Federal Railways in collaboration with the Swiss National Library, will be held in Lucerne from the 3rd to the 29th June, in the station lecture hall, beside the Congress House.

4. — *A full scale model of the historic train of 1847.* This train, which is popularly known as the « Spanisch-Brötli-Bahn » will consist of a locomotive, a first and second class carriage, two open and two closed third class carriages, and a van. There is room for 140 passengers seated and 20 standing on the train, which can run at a maximum speed of 30 km. (19 miles) /h. It will run from the end of April on certain sections, where there is but little traffic, throughout the country.

Between the 22nd and 29th June, this historic little train will run in the neighbourhood of Lucerne, on the Rotkreuz-Cham section, which is 12 km. (7 miles) long.

In the afternoon of Monday June 22nd, Thursday June 26th and Saturday June 28th a special train will be run for Railway Congress Delegates from Lucerne to Rotkreuz, to enable them to have a ride on the historic train.

The Delegates to the Congress will therefore be closely associated with the celebrations of the Swiss Jubilee. They will be able to visit the exhibitions at any time on production of their membership cards, and to take a ride on the historic train.

The Guide to the Congress, with which each Delegate will be issued on arrival in Lucerne, will give all the necessary information concerning these celebrations.

[385 (06 .111]

OFFICIAL INFORMATION

ISSUED BY THE

PERMANENT COMMISSION

OF THE

International Railway Congress Association

Meeting of the Permanent Commission, held on February 15, 1947.

The Permanent Commission of the International Railway Congress Association held a meeting on the 15th. February last in the Belgian National Railways' Headquarter Offices at Brussels.

* * *

The main object of this meeting was to consider the arrangements made for the organisation of the International Railway Congress, which will take place at Lucerne from the 23rd. to the 28th. June 1947. Several members of the Executive Committee of the Swiss Local Organizing Commission attended the Meeting.

Mr. GHILAIN, *Vice-President,* opening the meeting adressed a warm welcome to the personnalities present.

He then gave particulars about the changes which had occurred in the Permanent Commission since its last meeting.

The Meeting then elected the following as Members of the Permanent Commission :

Mr. F. Q. DEN HOLLANDER, Président des Chemins de fer Néerlandais;

Mr. BOUCIQUÉ, Directeur de la Voie de la Société Nationale des Chemins de fer belges;

Sir George E. CUFFE, Chief Commissioner of Railways for India,

to replace respectively Mr. HUPKES, Mr. HENNING, and Sir Leonard WILSON, who have resigned (Clause 6 of the Rules and Regulations).

The VICE-PRESIDENT announced the death of Mr. J. J. PELLEY, President of the Association of American Railroads, and proposed the nomination of Col. FLETCHER, his temporary successor to fill the vacancy.

He also said that M. LE BESNERAIS has resigned and that he will be replaced shortly.

The Meeting then considered a request from Poland for a second mandate at the Permanent Commission. This matter will be submitted to the approval of the next Congress.

* * *

The meeting then proceeded to elect a new *President of the Association,* to re-

place Mr. Henning, who retired at the end of July 1946 from the position of General Manager of the Belgian National Railways.

On the proposal of Mr. Boutet, Mr. F. H. Delory, actual General Manager of the Belgian National Railways, was elected unanimously *President of the International Railway Congress Association.*

Mr. Delory taking the chair, thanked the Members for the confidence placed in him and assured the Meeting he would carried out his duty to the best of his ability.

Mr. Meile, *President of the Executive Committee of the Swiss Local Organizing Commission,* gave particulars on the arrangements already made by this Committee, and about the allotment of time during the Session. He mentioned that a booklet-programme giving full information concerning the programme (daily routine) of the Session, the organization of the Congress, the official gatherings, technical visits and other outings as well as particulars regarding hotel accommodation, will be sent to all delegates.

Dr. Cottier, *Directeur de l'Office fédéral des Transports* (Switzerland), supplied some information about the facilities for exchanging money offered to the delegates.

The representatives of countries having Clearing agreements with Switzerland will be able to obtain cheques in Swiss francs. For the others, the necessary authorizations will be given to enable them to change at a time up to 500 Dollars per month, during the Session. The dollar banknotes (maximum 20 $) will be exchanged at the free rate of exchange.

The General Secretary then gave full particulars about the preparatory works of the 1947 Session at Lucerne. All reports on the questions to be discussed are in hand and their publication has been started in the *Bulletin* of December 1946.

Steps have been taken in order that the last reports will appear in the *Bulletin* of March 1947 so that they will be in hand of the delegates before their departure for Lucerne. The German edition of the reports will be distributed to such delegates who request them.

It was announced in connection with the appointment of the General Officers of the Session, that the President of the Swiss Confederacy, Dr. Philippe Etter, has been pleased to accept to act as Honorary President, and that the Vice-Presidency will be offered to Dr. Enrico Celio, Conseiller fédéral, chef du Département des Postes et des Chemins de fer. It was proposed to appoint Dr. Meile, Président de la Direction Générale des Chemins de fer fédéraux suisses, as acting President of the Session and also two Vice-Presidents, viz. Dr. Raphaël Cottier, Directeur de l'Office Fédéral des Transports, and Dr. Auguste Marguerat, Directeur des Chemins de fer Furka-Oberalp et Viège-Zermatt.

A decision was also reached regarding the appointment of presidents and vice-presidents for each of the five Sections among the various countries represented at the Session, also concerning the appointment of principal Sectional Secretaries.

Finally the Meeting appointed the two special Reporters, not yet nominated, who will be called upon to prepare summarised reports on the various questions and to present these at the sectional meetings for discussion.

These reporters are :

Question III. — M. E. F. Baron VAN HAERSOLTE, Secrétaire de la S. A. des Chemins de fer Néerlandais.

Question IV. — M. Francisco PINTO TEIXEIRA, Ingénieur, Directeur des Chemins de fer de Lourenço-Marques.

* * *

The Meeting next dealt with the arrangements made with the various European railways concerned in connection with travelling facilities for delegates to the Lucerne Congress.

It was stated that delegates will be supplied before their departure for Lucerne, with a membershipcard, which will enable them to reach Lucerne with the ladies whose names have been registered.

In addition, the delegates and the ladies (the latter by means of a special free pass) will be able to travel free on the lines of the Swiss Federal Railways and the Swiss private railways from June 10 to July 15, 1947.

During the same period, free travelling facilities will be also granted on the steamboats of the « Compagnie de bateaux à vapeur des Lacs suisses », on the Swiss funiculars, and the tramways and trolleybuses of the Swiss towns. Moreover, the cover of the membershipcard will entitle the holder to a reduction of 50 % on the Swiss Post Office motor omnibuses.

It was announced that many member Administrations and Governments had sent to the General Secretariat the names of their delegates to the Lucerne Congress and it is expected that the attendance at the Session will be very numerous

Invitations will also be forwarded to the most important technical publications and some daily papers to appoint a representative to the Lucerne Congress. As in the past, these journalists will be allowed to attend plenary meetings and also receptions and outings in connection with the Congress.

* * *

In accordance with art. 6 of the Rules and Regulations of the Association, one third of the members of the Permanent Commission are subject to re-election at each Session and it was decided to communicate with the 17 members whose mandate expires at the Lucerne Congress to invite them to accept a renewal of their membership. The appointments will be made at the first meeting of the Permanent Commission to be held in Lucerne. *(The appendix gives the list of the actual members of the Permanent Commission.)*

* * *

It was reminded that the Executive Committee had made a proposal to amend the Rules and Regulations, which was adopted by the Permanent Commission at the meeting of July 6, 1946.

This proposition is intended to amend art. 17 of the Rules and Regulations in order to ensure to the Association a sound financial situation, by increasing from 100 gold-francs to 200 gold-francs the fixed subscription of adherent Governments and Organisations. With regard to Member Administrations, to increase also the fixed contribution from 100 gold-francs to 200 gold-francs and bring to 1/3 gold-franc per kilometre the present maximum of 1/5 gold-franc per

kilometre relating to the variable subscription.

These alterations will be brought to the notice of all affiliated members at least 2 months before the opening of the Session. They will be submitted to the Congress to be discussed on the report of a special Committee composed of 11 members (art. 21 of the Rules and Regulations), who will be nominated by the Sections and the Permanent Commission at their first meeting at Lucerne, on the 23rd. June 1947.

* * *

The statement of receipts and expenditures for the year 1946 was approved by the Meeting as well as the provisional budget drawn up for the year 1947. As a result, to cover the estimated expenditures, the Meeting decided that the rate of the variable part of the yearly contribution for 1947 will be 0.15 gold-franc per kilometre, the maximum fixed in the Rules and Regulations being 0.20 gold-franc per kilometre.

* * *

The Meeting was then acquainted with the alterations, which occurred in the membership of the Association since the meeting held on July 6, 1946.

The Railway Congress Association at present includes 34 Governments, 11 Organisations and 150 Administrations with a total mileage of 279 617 (450 000 km.).

* * *

Finally, the Meeting dealt with various questions regarding the activities of the Association since the last meeting of the Permanent Commission.

A proposal to send an invitation to the Lucerne Congress to the Allied technicians of the 4 sectors in occupied Germany was adopted.

The General Secretary, P. Ghilain. *The President,* Delory.

List of Members of the Permanent Commission

OF THE

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

(February 15, 1947).

President :

F. H. **Delory** (2), directeur général de la Société Nationale des Chemins de fer belges ; 19, rue du Beau-Site, Bruxelles.

Vice-Presidents :

Goursat (3), directeur attaché à la Présidence du Conseil d'Administration de la Société Nationale des Chemins de fer français ; 88, rue Saint-Lazare, Paris (IXe) ;

P. **Ghilain** (1), directeur du Service du Matériel de la Société Nationale des Chemins de fer belges ; 19, rue du Beau-Site, Bruxelles.

Members of the Executive Committee :

Dorges (2), inspecteur général des Ponts et Chaussées, directeur général des Chemins de fer et des Transports au Ministère des Travaux publics et des Transports ; 244, boulevard Saint-Germain, Paris ;

Sir Cyril **Hurcomb** (3), director general, Ministry of Transport (Great Britain) ; Berkeley Square House, Berkeley Square, London, W. 1 ;

Sir William V. **Wood** (1), president of the Executive, London Midland and Scottish Railway ; Watford, Herts.

Ex-presidents of session, members ex-officio :

Baron Edouard **de Rothschild**, président du Conseil d'administration de la Compagnie du Chemin de fer du Nord français ; 27, avenue Bosquet, Paris ;

S. E. Ibrahim Fahmy **Kerim** Pacha ; Le Caire.

Members :

E. **Alfonso** (3), président du Conseil d'administration du Réseau National des Chemins de fer espagnols ; Madrid ;

Armand (2), directeur du Service central du Matériel de la Société Nationale des Chemins de fer français ; 20, rue de Rome, Paris ;

Besnard (1), chef de service adjoint au directeur général des Chemins de fer et des Transports, Ministère des Travaux publics et des Transports ; 244, boulevard Saint-Germain, Paris ;

Bouciqué (2), directeur du Service de la Voie de la Société Nationale des Chemins de fer belges ; 17, rue de Louvain, Bruxelles ;

Boutet (1), inspecteur général des Ponts et Chaussées, vice-président du Conseil d'administration de la Société Nationale des Chemins de fer français ; 88. rue Saint-Lazare, Paris (IXe) ;

O. V. **Bulleid** (2) Chief mechanical engineer, Southern Railway ; Waterloo Station, London, S. E. 1 ;

S. E. Mahmoud **Chaker Mohamed** Pacha (2), directeur général des Chemins de fer de l'Etat égyptien ; Le Caire ;

R. **Claudon** (2), inspecteur général des Ponts et Chaussées, membre du Conseil d'administration de la Société Nationale des Chemins de fer français ; 88, rue Saint-Lazare, Paris (IXe) ;

M. W. **Clement** (3), president, Pennsylvania Railroad Company ; Broad Street Station Building, 1617, Pennsylvania Boulevard, Philadelphia, 4, Pa. ;

Colle (3), directeur du Service de l'Exploitation de la Société Nationale des Chemins de fer belges ; 17, rue de Louvain, Bruxelles ;

Dr **Cottier** (3), directeur de l'Office fédéral des transports de la Confédération suisse ; Berne ;

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(1) Retires at the 14th session.
(2) Retires at the 15th session.
(3) Retires at the 16th session.

Sir George E. **Cuffe** (2), Chief commissioner of Railways for India; c/o Imperial Bank of India, 25, Old Broad Street, London, E. C. 2;

R. da **Costa Couvreur** (3), président du Conseil supérieur des Travaux publics au Ministère des Travaux publics et des Communications du Portugal; Avenida Antonio Serpa, 9-3°, Lisbonne;

G. O. W. P. **Dahlbeck** (1), directeur général et chef des Chemins de fer de l'Etat suédois; Stockholm;

Dargeou (2), directeur du Service central du Mouvement de la Société Nationale des Chemins de fer français; 8, rue de Londres, Paris (IXe);

J. **de Aguinaga** (1), sous-directeur général technique du Réseau National des Chemins de fer espagnols; Madrid;

Ing. V. **Dechitch** (1), administrateur principal des Chemins de fer de l'Etat yougoslave; Belgrade;

F. H. **Delory** (already named);

F. Q. **den Hollander** (3), président des Chemins de fer néerlandais, S. A.; Utrecht;

Ing. G. **di Raimondo** (3), directeur général des Chemins de fer de l'Etat italien; Rome;

Dorges (already named);

R. V. **Fletcher** (2), president, Association of American Railroads; Transportation Building, Washington 6. D. C.;

P. **Ghilain** (already named);

Goursat (already named);

R. J. **Harvey** (2), consulting engineer to the Government of New Zealand; 34, Victoria Street, Westminster, London, S. W. 1;

S. E. **Hefni Mahmoud** Pacha (3), Ministre des Communications d'Egypte; Le Caire;

Sir Cyril **Hurcomb** (already named);

L. **Jacobs** (3), directeur général de la Société Nationale belge des Chemins de fer vicinaux; 14, rue de la Science, Bruxelles;

S. E. Mohamed **Kamal El-Khichin** Bey (2), directeur général-adjoint des Chemins de fer de l'Etat égyptien; Le Caire;

A. **Kriz** (2), ingénieur, conseiller principal au Ministère des Communications de la République tchécoslovaque; Prague;

Dr N. **Laloni** (3), chef du Service Commercial et du Trafic des Chemins de fer de l'Etat italien; Rome;

Lemaire (1), directeur général de la Société Nationale des Chemins de fer français; 88, rue Saint-Lazare, Paris (IXe);

R. **Lévi** (1), directeur du Service central des Installations fixes et de la Construction de la Société Nationale des Chemins de fer français; 42, rue de Châteaudun, Paris;

M. **Malderez** (1), secrétaire général du Ministère des Communications de Belgique; 17A, rue de la Loi, Bruxelles;

A. **Marguerat** (3), directeur des Compagnies de Chemins de fer de Viège à Zermatt, Furka-Oberalp, Gornergrat et Schöllenen; Lausanne;

Ing. F. **Marin** (2), vice-directeur général des Chemins de fer de l'Etat italien; Rome;

Dr **Meile** (1), président de la Direction générale des Chemins de fer fédéraux suisses; Berne;

Ing. E. **Mellini** (3), inspecteur général technique de surveillance à l'Inspectorat général de la motorisation civile et des transports concédés; Rome;

Sir James **Milne** (1), general manager, Great Western Railway; Paddington Station, London, W. 2;

Sir Eustace **Missenden** (3), general manager, Southern Railway; Waterloo Station, London S. E. 1;

Sir Alan **Mount** (1), Chief inspecting officer of Railways, Ministry of Transport; Berkeley Square House, Berkeley Square, London, W. 1;

Sir Charles H. **Newton** (3), chief general manager, London & North Eastern Railway; Dorset Square, Marylebone, London, N. W. 1;

Nolet de Brauwere (2), Secrétaire Général de la Société Nationale des Chemins de fer belges; 17, rue de Louvain, Bruxelles;

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(1) Retires at the 14th session.
(2) Retires at the 15th session.
(3) Retires at the 16th session.

J. H. **Nuelle** (2), president, Delaware & Hudson Railroad Corporation; 32, Nassau Street, New York City;

Olivier (3), directeur général-adjoint de la Société Nationale des Chemins de fer belges; 17, rue de Louvain, Bruxelles;

Dr W. **Rauscher** (2), conseiller ministériel, directeur général adjoint et directeur du Service Commercial des Chemins de fer de l'Etat autrichien; Elisabethstrasse, 9, Vienne;

J. M. **Rivero de Aguilar** (2), directeur général du Réseau National des Chemins de fer espagnols; Madrid;

E. D. **Terkelsen** (2), directeur général des Chemins de fer de l'Etat danois; 40, Sölvgade, Copenhague, K.;

S. E. Mahmoud **Tewfik Ahmed** Bey (2), sous-secrétaire d'Etat au Ministère des Communications d'Egypte; Le Caire;

J. C. L. **Train** (1), Chief Engineer, London and North Eastern Railway; King's Cross Station, London, N. 1;

Th. M. B. **van Marle** (2), inspecteur-generaal van het Verkeer, Rijksverkeersinspectie; La Haye;

L. **Varga** (3), président de la Direction des Chemins de fer de l'Etat hongrois; Budapest;

F. Perez **Villamil** (1), sous-directeur général du Réseau National des Chemins de fer espagnols; Madrid;

Wagner (3), ingénieur en chef au Ministère des Communications de Pologne; Varsovie;

W. K. **Wallace** (2), Chief Engineer, London Midland and Scottish Railway; Watford, Herts;

Dr C. C. **Wang** (1), representative of Chinese Ministry of Communications; 21, Tothill Street, Westminster, London, S. W. 1;

H. D. **Ward Smith** (2), advisory engineer to the High Commissioner for the Union of South Africa; South Africa House, Trafalgar Square, London, W. C. 2;

R. B. **White** (3), president, Baltimore & Ohio Railroad Company; Baltimore, Md.;

G. **Willaert** (1), conseiller à la Direction générale de la Société Nationale des Chemins de fer belges; 17, rue de Louvain, Bruxelles;

Sir William V. **Wood** (already named);

N... (1) (Argentina);

N... (3) (Argentina);

N... (1), (Bulgaria);

N... (1) (Rumania).

Honorary member: U. **Lamalle**, directeur général honoraire de la Société Nationale des Chemins de fer belges, professeur de cours de chemins de fer à l'Université de Louvain; 175, avenue Winston Churchill, Uccle-Bruxelles.

Temporary Members of the Permanent Commission (Members of the Executive Committee of the Swiss Local Organizing Commission of the Lucerne Session 1947).

E. **Ballinari**, chef principal d'exploitation des Chemins de fer fédéraux, Direction générale des Chemins de fer fédéraux; Berne;

S. **Bittel**, directeur de l'Office Central suisse du Tourisme; Bahnhofplatz, 9, Zurich;

H. **Born**, secrétaire général de l'Union d'entreprises suisses de transports; Bundesgasse, 28, Berne;

E. **Branger**, directeur des Chemins de fer rhétiques, président de l'Union d'entreprises suisses de transports; Coire;

P. **Buchli**, chef de section à l'Office fédéral des transports; Berne;

G. **Dreyer**, chef de section au Secrétariat Général des Chemins de fer fédéraux, Direction générale des Chemins de fer fédéraux; Berne;

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(1) Retires at the 14th session.
(2) Retires at the 15th session.
(3) Retires at the 16th session.

W. **Fischer**, chef du service commercial des Voyageurs des Chemins de fer fédéraux, Direction générale des Chemins de fer fédéraux ; Berne ;

R. **Grimm**, directeur du Chemin de fer des Alpes Bernoises Berne-Loetschberg-Simplon ; Genfergasse, 11, Berne ;

F. **Hess**, directeur général des postes, télégraphes et téléphones ; Berne ;

H. **Hunziker**, directeur de l'Office Central des Transports Internationaux par Chemins de fer ; Monbijoustrasse, 36, Berne ;

M. **Lombardi**, chef du contrôle des finances et de la comptabilité générale des Chemins de fer fédéraux, Direction générale des Chemins de fer fédéraux ; Berne ;

C. **Lucchini**, directeur du IIe arrondissement des Chemins de fer fédéraux ; Lucerne ;

A. **Perrig**, directeur de la Société de navigation du Lac des Quatre Cantons ; Lucerne ;

E. **Schütz**, directeur du Bureau de Tourisme de la Ville de Lucerne ;

F. **Steiner**, chef du service technique de l'Office fédéral des transports ; Berne ;

F. **Wanner**, secrétaire général des Chemins de fer fédéraux, Direction générale des Chemins de fer fédéraux ; Berne.

SECRETARY'S OFFICE : 19, rue du Beau Site, Brussels.

General Secretary : P. **Ghilain** (already named).